

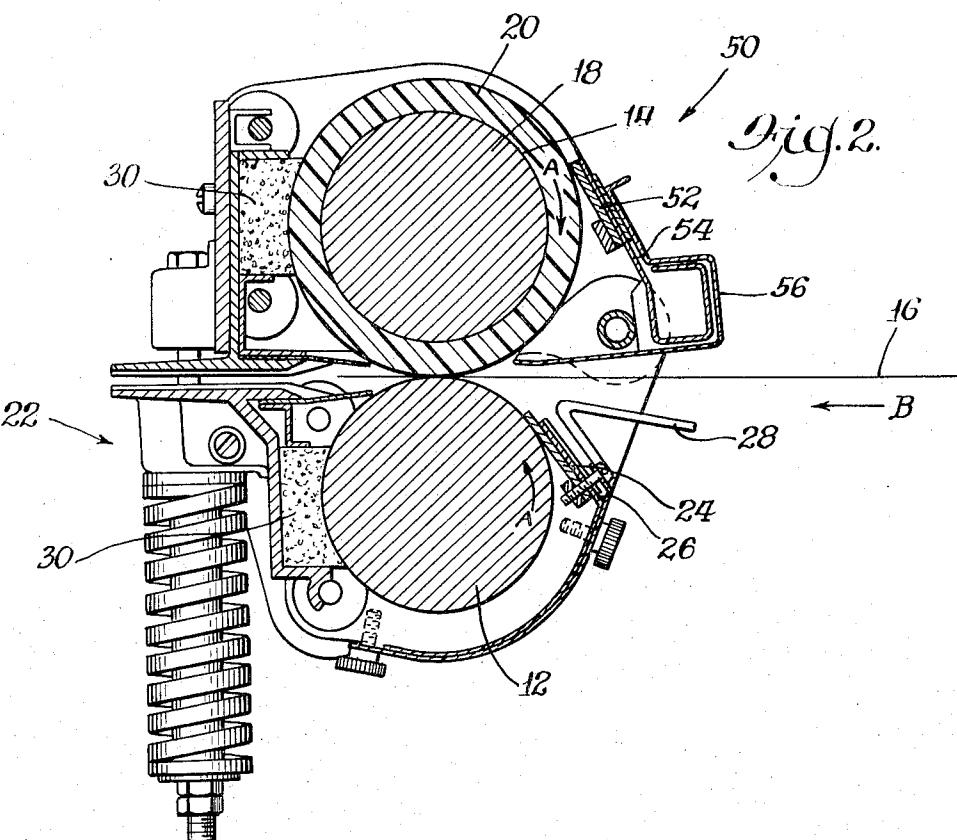
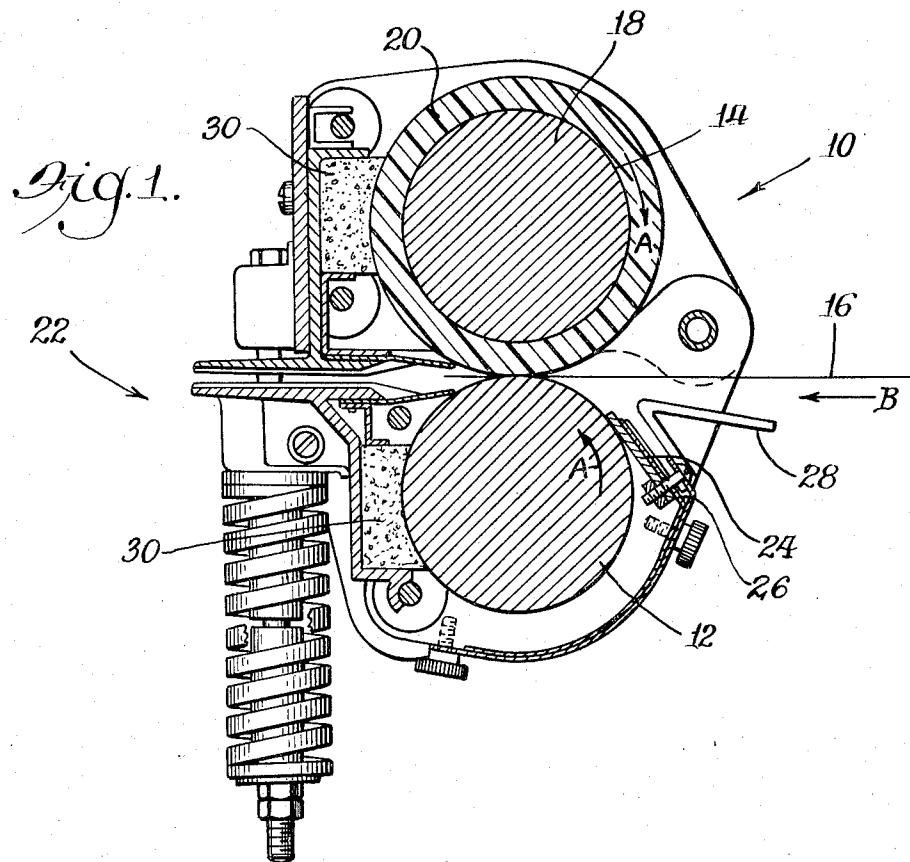
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J. ROTEMAN ET AL.

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FIXING DEVICE

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3,846,151 FIXING DEVICE

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8 Claims

ABSTRACT OF THE DISCLOSURE

An improved fixing device for fixing images of an original document on sheets of copy material includes two rollers in pressure engagement. The improved fixing device, in one embodiment, includes an emulsion of a release agent and an anti-static agent applied to the surface of one of the two rollers in pressure engagement. In a second embodiment, the improved fixing device includes a release agent applied to the surface of one of the two rollers and an anti-static agent applied to the surface of the other of the two rollers in pressure engagement.

BACKGROUND OF THE INVENTION

(A) Field of the invention

The present invention relates generally to copy making apparatus and, more particularly, to devices in such apparatus for fixing images of original documents on copy material.

(B) Description of the prior art

Devices for fixing images of original documents on light-sensitive sheets of copy material are well known in the prior art. One such device is disclosed in the co-pending application of Richard S. Brenneman et al. Ser. No. 51,089, filed June 30, 1970, and assigned to the same assignee as the present invention, and includes a pressure device for fixing images of original documents on copy sheets comprising two rollers in pressure engagement. A copy sheet having an image thereon formed by a resinous toner powder adhering to the electrostatically charged surface of the copy sheet is passed between the two rollers in pressure engagement. The powder image is thereby securely fixed in permanent form on the surface of the copy sheet by the application of pressure alone.

When a copy sheet is passed between the two rollers in pressure engagement, the toner powder adhering to the surface of the copy sheets has a tendency to release from the surface of the copy sheet and to adhere to the surface of one of the two rollers in pressure engagement. This occurrence is known as "offset." It is well known in the prior art to apply a release agent, such as a silicone oil, to the surface of a roller in contact with copy sheets to prevent the offset of toner powder. The use of the silicone oil release agent has eliminated many of the problems associated with the use of a fixing device such as that disclosed in the above-identified co-pending application.

However, the use of a release agent has not eliminated all of the objections to the use of such a fixing device. The most serious objection is the occurrence of jams in the fixing device caused by the tendency of copy sheets to wrap around the surface of one of the two rollers in pressure engagement.

The present invention addresses itself to this problem and has isolated the cause of the problem as being a build-up of static electricity across the two rollers in pressure engagement in the fixing device. The build-up of static electricity is thought to be caused by the passage of many sheets of dielectric copy material between the two

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rollers and by the transfer of the residual high voltage charge on the surfaces of the copy sheets to the surfaces of the rollers. The build-up of static electricity continues until it is sufficient to cause a copy sheet to adhere to the surface of one of the two rollers and to thus wrap itself about the surface of that roller, thereby causing a jam in the copy making apparatus.

SUMMARY OF THE INVENTION

10 An object of the present invention is to provide a new and improved device for fixing images of original documents on copy material.

15 Another object of the present invention is to provide a new and improved device for fixing images of original documents on copy material of the type that includes two rollers in pressure engagement.

Another object of the present invention is to provide a new and improved device for fixing images of original documents on copy material of the type having two rollers in pressure engagement and a release agent applied to the surface of one of the two rollers.

Another object of the present invention is to provide a new and improved device for fixing images of original documents on copy material having two rollers in pressure engagement and an emulsion of a release agent and of an anti-static agent applied to the surface of one of the two rollers.

Another object of the present invention is to provide a new and improved device for fixing images of original documents on copy material having two rollers in pressure engagement and an emulsion of a release agent applied to the surface of one of the two rollers and an anti-static agent applied to the surface of the other two rollers.

Briefly, the above and other objects of the present invention are achieved by a device for fixing images of original documents on copy material having two rollers in pressure engagement and a release agent and an anti-static agent applied either in an emulsion form to the surface of one of the two rollers or applied separately to the surface of one of the two rollers or to the surfaces of both of the two rollers to thereby eliminate both the offset of toner powder and the build-up of static electricity. In one embodiment, an emulsion of a release agent and an anti-static agent is applied to the surface of one of the two rollers in pressure engagement. In a second embodiment, a release agent is applied to the surface of one of the two rollers and an anti-static agent is applied to the surface of the other of the two rollers.

Brief Description of the Drawings

The above and other objects and advantages and novel features of the present invention are apparent from the following detailed descriptions of the preferred embodiments of the invention illustrated in the accompanying drawings wherein:

FIG. 1 is a sectional view of a preferred embodiment of a fixing device embodying features of the present invention; and

FIG. 2 is a sectional view of a second preferred embodiment of a fixing device embodying features of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings and initially to FIG. 1, there is disclosed a new and improved fixing device generally designated as 10 constructed in accordance with the principles of the present invention. The fixing device 10 serves to fix an image of an original document on a paper copy sheet, to eliminate the offset of toner powder, and to reduce the tendency of the copy sheet to become entangled

in the fixing device **10** and thereby cause a jam condition in the copy making apparatus.

The fixing device 10 is an improvement of the device disclosed in the above-identified co-pending application and includes two rollers 12 and 14 in pressure engagement to thereby fix a powder image of an original document on a light-sensitive sheet of copy material 16 by the application of pressure alone. The rollers 12 and 14 revolve in the direction of the arrow "A" to pass the copy sheet 16 through the device 10 in the direction of the arrow "B." The roller 12 preferably is formed of steel and the roller 14 preferably comprises a steel core 18 and an outer nylon housing 20. The fixing device 10 further includes an assembly 22 for increasing or decreasing the pressure contact of the rollers 12 and 14.

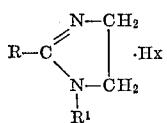
In accordance with an important advantage of the present invention, the fixing device 10 includes an applicator 24 for applying certain solutions to the surface of the steel roller 12. The applicator 24 applies a thin layer of liquid to the surface of the steel roller which performs a two-fold function. The solution contains a releasing agent and an anti-static agent, the former serving to prevent the adherence of the toner powder to its surface, and the latter acting to prevent the development of static charges on the surface of the paper which would inhibit the freedom of movement of the sheet as it makes its exit from between the rollers. It will be appreciated that in the construction shown in FIG. 1 there is only one applicator 24 which applies both treating agents to the roll through the medium of a single liquid formulation.

The treating liquid is comprised of an emulsion formed of the release agent and the anti-static agent. The emulsion is contained in a saturated felt wick 24 and is drawn by capillary action through the wick 26 to the applicator 24 for application to the surface of the roller 12. One suitable material for the applicator 24 is porous nylon. The wick must be replaced after a predetermined operating of the device 10 with a new saturated wick 26.

The fixing device 10 further includes guide member 28 for guiding a copy sheet 16 into the nip between the rollers 12 and 14, and two wiping members 30 which are employed for the purpose of cleansing the surfaces of the rollers 12 and 14.

In accordance with a further important advantage of the present invention, the release agent and the anti-static agent are applied to the surface of the roller 12 in an emulsion 4, so as to make available both the release properties of the releasing agent and the anti-static properties of the anti-static agent in a single liquid application.

One class of anti-static agents that have been successfully used in the instant invention are those which can be emulsified in the environment in which there are used, Compounds having the following general formula:



are particularly useful.

These materials are fatty imidazolines and their salts. A compound, sold under the trade name C-100-L, which comes within the general formula, is sold by the Hodag Chemical Corporation, has produced excellent results.

The release agent portion of the emulsified applicator liquid which is used in the improved pressure device of this invention, may be any one of the commercially available, well-known, silicone oils, such as dialkyl polysiloxane.

The construction of the copy material 16 is such that it is formed by dispersing zinc oxide pigments in a resin binder system in order to impart the light sensitive characteristics to the copy sheet 16. The release agent and

the anti-static agent which is applied to the surfaces of the rollers 12 and 14, must therefore avoid having any solvency action on the zinc oxide coating. The silicone oil release agents which have been described hereinabove, conform to this requirement.

The use of the release agent with certain anti-static agents in an emulsion form, has been found to be less than totally effective in eliminating the build-up of static electricity in pressure fixing devices of the instant invention. This is thought to be due to the tendency of these anti-static agents to separate from the emulsion so that the anti-static agent is not uniformly dispersed throughout. Further, some of the anti-static agents are known to evaporate at a different rate than the release agents, so that ultimately the emulsion reaches an imbalance or otherwise complete depletion of the anti-static agent from the system so that its remedial effect is no longer present. Under such unstable conditions, after the processing of many sheets of copy material, it has been found that the applicator 24 is applying only the release agent to the exclusion of the other agent to the surface of the roller 12.

If, as is usually the case, the anti-static agent is the excluded agent, a common, undesirable build-up of static electricity occurs across the surfaces of the rollers 12 and 14. Hence, the copy sheet 16 is attracted to the surfaces of the rollers 12 and 14, resulting in paper jams. To eliminate this problem, a second embodiment of the present invention, such as illustrated in FIG. 2, comprises a fixing device 50 having two similar applicators, 24 and 52, one for applying the release agent to the surface of one of the rollers 12 or 14, and the other for applying the anti-static agent to the surface of the other roller. For example, the applicator 24 may be used to apply the release agent to the surface of the roller 12; and the applicator 52 may be used to apply the anti-static agent to the surface of the roller 14. The applicator 24 draws the release agent by capillary action through the felt wick 26 for application to the surface of the roller 12; and the applicator 52 draws the anti-static agent through a felt wick 54 for application to the surface of the roller 14. The wicks 26 and 54 advantageously have compensating storage capacities so consistent with their rate of usage so that the agents are depleted at approximately the same time, thereby minimizing the servicing requirements of the copy machine.

It will be appreciated that many elements of the fixing device 50 are the same as those of the fixing device 10 in FIG. 1, and are thus designated by the same reference numerals. The device 50 (FIG. 2) includes an additional paper guide 56 for guiding the copy sheet 16 into the nip between the rollers 12 and 14.

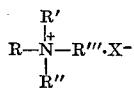
The release agent to be applied to the surface of the roller 12 by the applicator 24 may be the same as the release agent discussed previously with reference to the device of FIG. 1. However, it will be understood that no other ingredient need be included in the formulation since it is only functioning as a release agent.

Similarly, the anti-static agent to be applied to the surface of the roller 14 by the applicator 52, may be the same as the anti-static agent discussed previously with reference to the embodiment of FIG. 1. In view of the fact that the anti-static agent is not being combined with the release agent, there is a great deal more latitude in the formulation since it is no longer necessary for the anti-static agent to be uniformly contained in the solution through emulsification with the silicone release agent.

In the formulation of the treating liquid to be used with the apparatus of FIG 2, the anti-static agent is usually combined with a carrier fluid such as polyethylene glycol in order to form a liquid-liquid solution in which may be carried the very small amounts of the anti-static agents. The polyethylene glycol is a desirable carrier because of its low volatility, inert effect on the zinc oxide resin binder system, and because it is somewhat hydro-

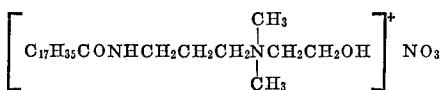
scopic, which has been found to be helpful in the instant application.

An anti-static agent that has been successfully used in the second embodiment is a lauryl quaternary ammonium salt sold by the Hodag Chemical Corporation under the designation CQ-14. The molecular structure of this quaternary ammonium salt is as follows:

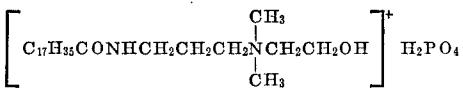


wherein R is lauryl; R' and R'' are lower alkyl radicals; and X is an anion. This anti-static agent is usually dissolved in alcohol and when added to a carrier fluid such as polyethylene glycol in the proportion of 10 parts of anti-static agent and 90 parts of the carrier fluid, forms a homogeneous treating solution which may be uniformly applied in a thin film to the roller 14. This solution enables the properties of the anti-static agent to have its effect on the fixing device 10, while the release agent is being applied to the roller 12 through its applicator 24, thereby giving the same effect as when using the emulsion with the fixing device of FIG 1.

Many other anti-static quaternary ammonium agents may be used in accordance with the principles of the present invention as described in connection with FIGS. 1 and 2. The American Cyanamid Company manufactures and sells two anti-static agents that could be used with the device of the present invention. One of these two anti-static agents is known as a Catanae SN Anti-static Agent (stearamidopropylidimethyl - B-hydroxyethylammonium nitrate) and has a molecular formula as follows:



Another suitable anti-static agent manufactured and sold by the American Cyanamid Company is known as a Catanae SP Anti-static Agent (stearamidopropylidimethyl-B-hydroxyethylammonium dihydrogen phosphate) and has a molecular formula as follows:



In addition to the anti-static agent available from the Hodag Chemical Corporation discussed above, these two anti-static agents manufactured and sold by American Cyanamid Company, can be used together with a suitable carrier liquid for the separate application to the fixing device 10. Agents suitable for use in the device of the present invention are listed in the book entitled "Detergents and Emulsifiers" by McCutcheon (1970 Ed.), on pages 39 through 256. Thus, many emulsions may be prepared for use with the anti-static agents of the instant invention as well as the use of these anti-static agents in a solvent.

Many modifications and variations of the present invention are possible in light of the above teachings. For example, with reference to the embodiment of FIG. 2, the two applicators 24 and 52 may be positioned in contact with the surface of a single roller, 12 or 14, to thereby apply the release agent and the anti-static agent

at separate locations to the same roller. Furthermore, it is apparent that beneficial results would evolve from the application of a release agent and an anti-static agent to the surfaces of any two rollers in engagement in a copy making apparatus in accordance with the principles of the present invention. Thus, it is to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by Letters Patent of the United States is:

- 10 1. A method for reducing the tendency of a single sheet of a predetermined length of copy material having at least a residual high voltage charge thereon and of toner powder on said sheet of copy material to adhere to the surface of one of two rollers in pressure engagement at ambient temperature in a fixing device in a copy making apparatus for pressure fixing an image of an original formed of said toner powder comprising the steps of
 - 15 passing said sheet of copy material into the nip of said two rollers to pressure fix said toner powder,
 - 20 applying a release agent to the surface of a first one of said two rollers, and
 - 25 applying an anti-static agent to the surface of a second one of said two rollers.
- 25 2. A device in a copy making apparatus for fixing an image of an original formed of toner powder on a single sheet of a predetermined length of copy material having at least a residual high voltage charge thereon comprising means for applying pressure to the surface of said sheet of copy material, said pressure applying means comprising two rollers in pressure engagement, an emulsion, said emulsion comprising means for inhibiting the tendency of said toner powder to become attached to the surface of one of said two rollers and means for preventing the buildup of a static electric charge in said fixing device, said inhibiting means comprising a release agent and said preventing means comprising an anti-static agent, and
 - 30 means for applying said emulsion to the surface of one of said two rollers.
 - 35 3. A device as defined in claim 2 wherein said release agent comprises a silicone oil.
 - 40 4. A device as defined in claim 3 wherein said silicone oil comprises a dialkyl polysiloxane.
 - 45 5. A device for forming an image of an original formed of toner powder on a single sheet of a predetermined length of copy material having at least a residual high voltage charge thereon comprising
 - 50 a pair of rollers in engagement,
 - 55 means for passing said sheet of copy material between said pair of rollers,
 - 60 an emulsion, said emulsion comprising means for inhibiting the tendency of said toner powder to become attached to the surface of one of said pair of rollers and means for preventing the buildup of a static charge between said pair of rollers, said inhibiting means comprising a release agent and said preventing means comprising an anti-static agent, and
 - 65 means for applying said emulsion to the surface of one of said two rollers.
 - 70 6. A device as defined in claim 5 wherein said release agent comprises a silicone oil.
 - 75 7. A device as defined in claim 6 wherein said silicone oil comprises a dialkyl polysiloxane.
 8. A method for reducing the tendency of a single sheet of a predetermined length of copy material having at least a residual high voltage charge thereon and of toner powder on said sheet of copy material to adhere to the surface of one of two rollers in pressure engagement in a fixing device in a copy making apparatus comprising the steps of
 - 75 passing said sheet of copy material into the nip of said two rollers and

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applying an emulsion of a release agent and of an anti-static agent to the surface of one of said two rollers.

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MICHAEL SOFOCLEOUS, Primary Examiner
U.S. Cl. X.R.

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