

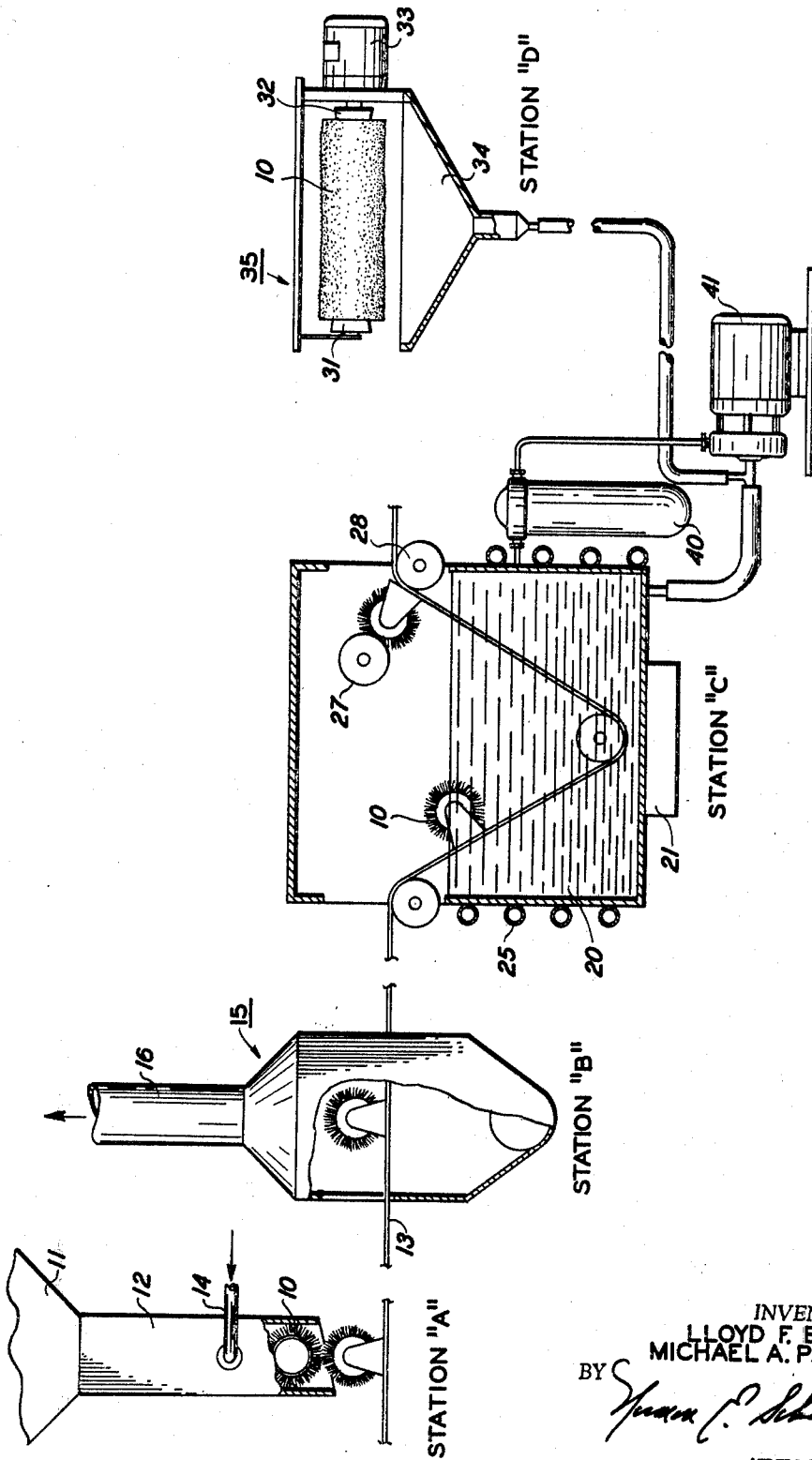
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BRUSH RECLAIMING

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BRUSH RECLAIMING

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5 Claims

ABSTRACT OF THE DISCLOSURE

A method for cleaning soils from a cleaning brush without damaging the brush hair fibers or the brush support material. The brush is scrubbed in a solvent bath by ultrasonic waves and then rapidly dried with the hair fibers in a natural extended posture.

This invention relates to reclaiming a fur brush and, in particular, to method for rapidly cleaning the fibers of a fur brush.

More specifically, this invention relates to reclaiming a cleaning brush which has been used to remove residual xerographic powder resins, herein referred to as "toner," from a photoconductive surface. In the xerographic process, a surface of a plate comprising a photoconductive insulating coating placed upon a conductive backing is charged uniformly and the photoconductive surface then exposed to a light image. The photoconductive coating becomes conductive under the influence of the light so as to selectively dissipate the electrostatic charge found thereon/or therein to produce a latent image. The latent image is then developed by means of a variety of pigmented resins which have been specifically developed for this purpose. The resins or toners are electrostatically attracted to the latent image on the photoconductive surface in proportion to the amount of charge found thereon/or therein so that areas of small charge concentration become areas of low toner density while areas of greater charge concentration become proportionally more dense. The developed image is then transferred to a support material and permanently affixed thereto.

Transfer of a developed latent image is effected usually by a corona generating device which imparts an electrical charge sufficient to attract the powder image from the photoconductive surface to the support surface. The magnitude of the charge required to effect image transfer is dependent upon many variable but, in any event, a slight residue of developing material, or toner, remains behind on the photoconductive surface. That is, although the electrostatic transfer forces applied to the support material affect transfer of a predominance of the developed image thereon, at times it may be inadequate to overcome a higher magnitude of forces that tend to retain some of the particles to the photoconductive surface. This residual toner left behind after transfer, therefore, must be removed in some manner before the plate can be reused in the xerographic process.

A common method of removing residual toner from a xerographic plate is to treat the xerographic plate with a fur brush after the transfer operation is completed, the fur brush usually being moved rapidly over the plate surface to effect the desired cleaning. The fur is given form and substance by mounting it on a support, the support then being positioned so that the fur fibers come in contact with the surface to be cleaned. For example, when a xerographic drum is cleaned, the cleaning fur is mounted on a cylindrical core positioned so that the fibers of the fur strike the drum surface when the brush is rotated. Rapidly moving the fibers of a fur brush over a photoconductive surface causes the residual toner found

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thereon to be both mechanically and triboelectrically removed. In most automatic xerographic machines, apparatus is provided to flick and vacuum clean the cleaning brush in an attempt to remove residual toner adhering thereto. However, it has been found that the mechanical forces are such as to cause a residual buildup around the brush fibers regardless of flicking, vacuuming or the like, the residual buildup being particularly noticeable in the tight underwool portion of natural fur cleaning brushes. Any excessive buildup of residual toner in a cleaning brush, if left uncorrected, will cause a physical abrading of the photoconductive surface being cleaned. Abrading of the photoconductive surface cannot be tolerated in the xerographic process and, therefore, the cleaning brushes must be periodically removed from the apparatus and cleaned.

Although synthetic cleaning brushes are quite satisfactory, natural fur cleaning brushes are widely used in the xerographic process because of the natural fur's softness and inherently good triboelectric properties. However, cleaning of a natural fur has heretofore been a difficult, time consuming, and costly process. The most widely used method of cleaning a natural fur in commercial use has been the process known as "drumming" in which the furs are placed in large wooden tumblers and slowly rotated for a relatively long period of time, the tumbling action being such as to produce a relatively gentle cleaning capable of removing soils, dirt, and the like without injuring the natural fibers of the fur. To enhance the tumbling cleaning operation, finely ground sawdust, nutshells, flour or the like are placed within the tumbling drum, the particulate material gently abrading the fur fibers. Although very effective in cleaning the natural fur itself, the tumbling method has proven to be destructive when the fur is mounted on a fragile support material such as a paper core or the like. The constant agitation of the tumbling motion is such as to destroy the support material thereby rendering a brush unusable.

Chemical treating of natural and synthetic furs is another method of cleaning that has been used with some degree of success. However, chemically cleaning a natural fur has proven to be difficult and oftentimes an unsatisfactory method because of the harsh effect such cleaning solvents have upon the fur fibers. That is, exposure of the natural fur or synthetic furs to chemical solvents for a period of time necessary to dissolve or dislodge deep seated soils is such as to adversely affect the hair fibers. In natural furs the cleaning chemicals have been found to cause shrinkage of the fur pelts, shredding of the natural hair fibers, removal of the natural hair oils, and matting of the tight underwool thereby depriving the fur of its natural body. Again, consideration must also be given to the support material when chemically cleaning a fur brush. Prolonged exposure of a brush to a chemical solvent may be such as to permanently damage either the support material or the bonding medium.

It is therefore an object of this invention to provide an improved method of refurbishing a contaminated fur brush.

A further object of this invention is to refurbish a natural fur cleaning brush.

A still further object of this invention is to remove residual xerographic toner mechanically adhered to the fibers of a cleaning brush.

Another object of this invention is to provide a method for reclaiming a fur brush without damaging the brush fibers or the brush support material.

Yet another object of this invention is to rapidly and efficiently remove xerographic toner from the fibers of a natural fur which is bonded to a support material.

These and other objects of this invention are obtained by scrubbing rapidly and forcefully the fur fibers of a

contaminated cleaning brush with a solvent to remove residual xerographic toner adhering thereto and then rapidly restoring the brush to its dry state with the hair fibers in a uniform extended posture.

For a better understanding of this invention as well as the objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawing, wherein:

The figure is a schematic representation of an embodiment of apparatus for accomplishing the present invention.

In automatic xerographic machines, the photoconductive plate is oftentimes fabricated in the form of a drum, the drum adapted to pass through the various xerographic processing stations repeatedly for an indefinite number of cycles. As previously noted, residual toner remaining on the drum after the transfer of the developed image to a support material must be removed therefrom prior to the beginning of a new cycle. A cylindrical shaped cleaning brush is usually mounted in close proximity to the drum shaped photoconductive surface so that some interference exists between the photoconductive surface to be cleaned and the fur fibers of the brush. The cleaning brush is then rotated at relatively high speeds, the movement of the brush causing removal of residual toner by mechanical forces and/or triboelectric attraction. Such a cylindrical shaped cleaning brush **10** is shown in the figure being processed through the various refurbishing stations. It should be understood that the subject matter of the present invention, however, is not restricted to any size or shape brush and a cylindrical brush is used for descriptive purposes only because of its wide usage in automatic xerographic machines. For further information considering a suitable plate cleaning apparatus using rotary brushes, reference is had to L. Walkup et al. Patent No. 2,832,977.

In accordance with the present invention, there is provided a new and improved method of rapidly and efficiently refurbishing a xerographic cleaning brush which has become contaminated with xerographic toner.

As shown in the figure, the core of the cylindrical cleaning brushes are air cleaned at station A. The brushes are loaded into hopper **11** where they are fed seriatim into chute **12**. Located in the chute is a nozzle (not shown) which is supplied with air under high pressure through line **14** capable of air blowing soils or residual toner from the inside of the core support material. The brushes are then carried to the next processing station by means of belt transport **13** or the like.

At station B the brushes are placed in an air chamber **15** where they are subjected to an air blast of sufficient velocity to remove residual toner loosely adhering thereto, the brushes being rotated in the air blast so the entire periphery of the brush surface is treated. The residual entrapped in the air stream is then carried away by means of exhaust line **16**. It has been found that utilizing an air stream having a pressure of between 60-80 p.s.i. will remove most of the loosely adhered toner particles bonded to the outer extremities of the hair fibers. However, the mechanical forces holding this residual toner in the closer grouped inner fibers, especially in the tighter or coarser underwool portion of a natural fur brush, are strong enough to retain the particulate material thereto even when much higher pressures are used. The mechanical bond holding particulate material in the underwool portions of natural furs are generally such to sustain all but the strongest air blasts.

One toner in common usage today is comprised of about 5 to 10 percent organic materials, usually comprising the coloring pigments, and 90 to 95 percent organic resins such as styrene, polymerized, or blends thereof which is ground into finely divided material. For further information concerning such toners, reference is had to C. F. Carlson reissued patent No. 25,436. It is presently believed that a great deal of difficulty in cleaning toner from a fur

brush is caused by or is a function of the physical and mechanical properties of the fine toner particles. That is, the particulate toner material will be mechanically bonded as it is forced or packed together during the xerographic cleaning process. Apparently, toner readily adheres to the more closely spaced internal hair fibers or underwool fibers of a natural brush by mechanical means which are extremely difficult to overcome and, therefore, conventional methods of fur cleaning have, for various reasons, proven to be ineffectual in removing this tight bonding residual toner from a cleaning brush.

In the present invention, brushes **10** are transported from the air cleaning station to a bath of cleaning solvent capable of dissolving or partially dissolving the organic portion of the finely divided toner material. A tank **20** is located at station C capable of holding a quantity of such cleaning solvent. Affixed to the bottom of the tank are transducers **21** capable of inducing supersonic sound waves in the liquid solvent which in turn cause cavitation of the vapor bubbles found therein. The intensity of the energy released by the cavitation, or destruction of the vapor bubbles, being such as to scrub the hair fibers of the fur to dislodge soils tightly adhering thereto. The scrubbing action produced by the induced cavitation of the liquid solvent combined with the solvent action upon the xerographic toner produces a thorough hair fiber cleaning operation in an extremely short period of time.

Care should be taken, however, to select a solvent which is capable of dissolving or partially dissolving the organic portion of the toner material within the short bath access time but yet will not adversely affect the core material or the bonding medium holding the fur to the core. In the present invention, the time of immersion of a cleaning brush in the bath is so short that neither the support material nor the bonding medium is adversely affected. For instance, a rabbit fur brush glued to a kraft paper core was immersed in a bath of trichloroethylene, the brush being heavily contaminated with a styrene based toner and the bath subjected to ultrasonic sound waves at approximately 30 kilocycles. After about 20 seconds of exposure, the brush was removed from the bath and dried. The brush, so cleaned, was found to be extremely free of residual toner and soils and the support material and bonding material, because of the short exposure time, unaffected by the solvent.

Although the fusing temperatures of most xerographic toners are relatively high, usually between 180° F. and 275° F., the toner particles tend to become tacky and stick together at temperatures considerably lower than the fusing temperatures. It is therefore expedient in the present invention to maintain a bath temperature below the toner blocking temperature, blocking temperature as herein used being the temperature at which the particulate toner material becomes tacky enough to form toner blocks. Implosion of vapor bubbles in a liquid, especially liquids having relatively high vapor pressures, causes the release of a great deal of energy, some of which is absorbed in the liquid as heat energy. In order to prevent excessive heat buildup in the bath, cooling coils **25** are placed around the solvent bath, the coils being capable of maintaining the solvent bath below the tackifying or blocking temperature of the toner material.

As shown in FIG. 1, the brushes are immediately squeezed upon leaving the solvent bath to remove a predominance of the liquid solvent remaining thereon. The fur brushes **10** are driven between squeegee roll **27** and platen roll **28**, the squeegee roll being rotated at a speed sufficient to squeeze the entire periphery of the fur brush during the time the two are in working contact. Squeegeeing operations are conducted under hood **29** of the solvent tank so that excess solvent removed from the brush is returned to the bath thereby reducing solvent drag out.

After squeegeeing, the brushes are transported to station D where they are subjected to a high speed spinning

operation. At station D the brushes are mounted between arbors 31 and 32, respectively, and then rotated at high speed by means of motor 33 which is operatively connected to arbor 32.

Rapidly spinning a fur cleaning brush in ambient air produces a two-fold drying effect. First, the rapid spinning action mechanically removes excess solvent by means of centrifugal force in that the liquid droplets are thrown from the brush as it rotates at relatively high speed. Second, rapidly spinning the brush in ambient air causes evaporation of the cleaning solvent especially where solvent vapor pressure is relatively high. Another, and probably more important, function of the rapid spinning operation is that a natural fur brush will return to approximately its original pre-bath posture when rapidly spun while it is drying. It is found that the hair fibers which are forced outwardly by the spinning action will dry in this extended position thereby producing a permanent set. As previously noted, proper fiber extension is extremely important in fur brush refurbishing to ensure that the brush will have the length of fiber to produce the needed interference with a photoconductive surface when replaced in a xerographic machine. Spinning speeds of between 3,000 and 4,000 r.p.m. have been found sufficient to rapidly restore a cleaning brush to this required original posture. Although spinning a brush in one direction gives satisfactory results, best results have been obtained when the direction of brush rotation is reversed midway through the spin drying operation thereby reducing the tendency of the hair fibers to curl. As seen in FIG. 1, the spin dry operation is also carried on in a closed housing 35 where the excessive solvent removed is being collected in funnel shape sump 34.

As noted, the organic materials found in the residual toner are dissolved or partially dissolved in the solvent while the inorganic materials are dispersed and carried away suspended in the liquid. It is therefore necessary to both distill and filter the bath liquid to prevent recontamination of the brush while still in the bath. A filtering and distilling unit 40 is shown operatively connected to tank 20 in FIG. 1. A pumping unit 41 develops a suction head of sufficient strength to remove continually solvent from tank 20, the solvent so removed is then passed through filtering and distilling unit 40 wherein the soils, both organic and inorganic, are purged from the liquid. The treated solvent is then pumped back into tank 20 thereby producing a continuous flow of cleaned solvent through the tank. Sump 34, located in housing 35 of station D, is also placed in communication with the suction end of the pumping unit. Excess solvent removed from the brushes during the spinning operation is recovered, filtered, distilled, and returned to the bath thereby further eliminating solvent waste.

The removal of xerographic toners which are primarily comprised of organic resins from a natural fur, as opposed to a synthetic, cleaning brush presents a special cleaning problem. Natural furs are such as to require special handling during cleaning to prevent breaking down of the rather delicate hair fibers found in both the guard hair and underwool. Adhering a fur to a support material such as paper or the like further compounds the difficulty of cleaning in that consideration must be given to added materials. In the present invention a natural fur cleaning brush can be rapidly cleaned of residual xerographic toner or other soils adhering thereto without removing the fur from the support material by immersing the brush in a solvent for a relatively short period of time while the fibers are scrubbed by ultrasonic sound waves. The period of immersion in the solvent bath being short enough to protect the fur, material, and the support material from being degraded by the chemical solvent. Spin drying of the natural fur brush immediately after removal from the solvent bath quickly restores the natural fur fibers once again to their original posture,

a property which is essential if the brush is to be reused in an automatic xerographic apparatus.

The liquid solvent recommended for use in the method of the invention as applied to cleaning resin type xerographic powder from a fur cleaning brush are preferably chlorinated hydrocarbons such as trichloroethylene. It is apparent that a wide variety of resin type xerographic powders can be found deposited on a cleaning brush, it being necessary therefore to use a solvent which will dissolve or partially dissolve the particular material of which the powder is composed. Examples of solvents useful with specific powders are:

Styrenes and polystyrenes—chlorinated aliphatic hydrocarbons.

Acrylates and polyacrylates—benzene and chlorinated hydrocarbons.

Methacrylates and polymethacrylates—ethanol/carbon tetrachloride.

Nylons—trichloroethanol.

It should be further noted that this process, although primarily advantageous in refurbishing natural fur brushes, is in no way limited thereto. Synthetic cleaning brushes are also rapidly and efficiently restored utilizing this process. However, here again, care should be taken to choose a bath material which will not adversely affect the synthetic fibers of such a cleaning brush. While the present invention has been described with reference to the structure disclosed herein, it is not confined to the details set forth, and this application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

What is claimed is:

1. The method of reclaiming a natural fur cleaning brush which is contaminated with resinous, heat sensitive, toner particles including:

removing loosely adhering toner particles from the hair fibers of a natural fur cleaning brush by placing the hair fibers in communication with a rapidly moving air stream,

providing a bath of liquid solvent being capable of breaking down and dissolving the resinous, heat sensitive toner material,

immersing the natural fur cleaning brush in said bath for a predetermined time,

scrubbing the natural hair fibers of the immersed brush by ultrasonic sound waves existing at wave lengths of between 20 and 40 kilocycles which are induced in the liquid solvent bath,

maintaining the solvent bath at a temperature below the blocking temperature of the heat sensitive toner particles,

spinning the brush to dryness whereby the brush fibers dry in substantially a uniform straight posture.

2. The method of claim 1 wherein the brush is immersed in the solvent bath from between 10 and 30 seconds.

3. The method of cleaning a fur brush which has been contaminated with heat sensitive soils including:

removing loosely adhering soils from the brush by placing the hair fibers in communication with a rapidly moving air stream,

providing a bath of liquid solvent being capable of breaking down and dissolving the heat sensitive soil material,

immersing the fur brush in said bath for a predetermined period of time,

scrubbing the hair fibers of the immersed brush with ultrasonic sound waves to rapidly dislodge soils tightly adhering thereto,

cooling the solvent bath to dissipate the heat energy induced therein by said last mentioned step wherein the temperature of the bath is maintained below the agglomerating temperature of the heat sensitive soil material,

drying the brush fibers in a natural, radially extended,

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posture wherein the outside periphery of the brush remains unchanged.

4. The method of claim 3 wherein said scrubbing is produced by ultrasonic sound waves existing at wave lengths of between 20 and 40 kilocycles.

5. The method of claim 4 wherein the brush is dried by spinning said brush at speeds in excess of 3,000 revolutions per minute in ambient air.

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15—4; 134—33, 37, 75