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METHOD OF PREVENTING THE ADHERENCE OF STACKED SHEETS

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Fig. 1

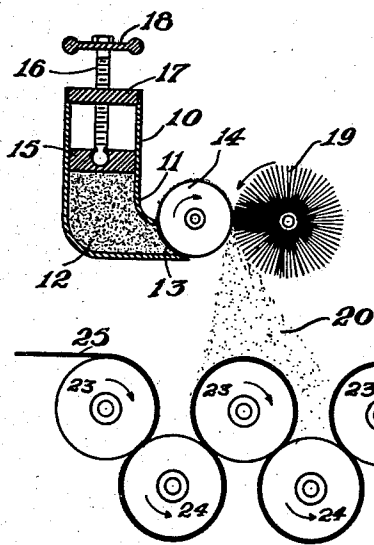


Fig. 2

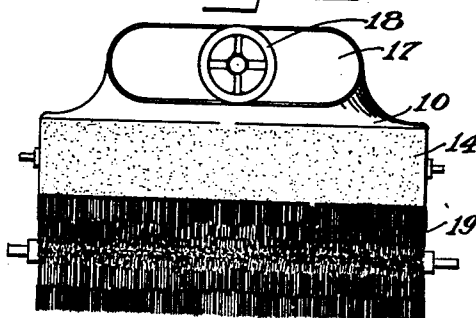


Fig. 3

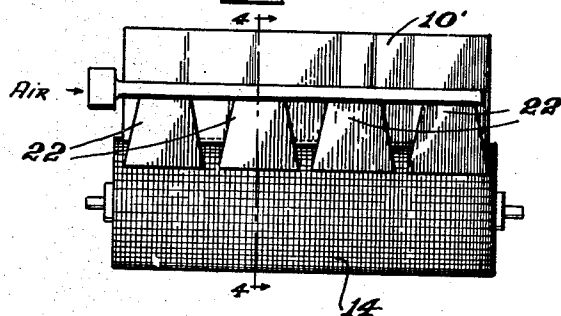
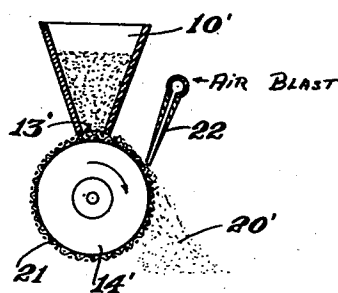


Fig. 4



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METHOD OF PREVENTING THE ADHERENCE
OF STACKED SHEETS

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13 Claims. (Cl. 91—68)

The invention relates to a method for modifying the surface characteristics of non-fibrous, relatively plastic sheet materials and the article produced thereby.

There are in use for packaging merchandise and for other purposes, flexible sheet materials formed from non-fibrous, relatively plastic materials such, for example, as cellulose hydrate, cellulose derivatives, gelatine, polymerized vinyl compounds, synthetic resins, etc. These sheet materials are characterized by having a high surface gloss, a high degree of transparency, a smooth surface and a relative degree of expansibility when stretched. To preserve and/or increase their flexibility and expansibility, it is customary to incorporate in such sheet materials an appropriate plasticizer. The amount of plasticizer incorporated is usually the maximum amount compatible with retaining a suitable non-tacky surface. However, this amount is varied to take into account the season of the year and the atmospheric conditions, such as temperature and relative humidity under which the material is made, stored and used.

To illustrate the practice of the prior art, "cellophane" (glycerinated sheets of cellulose hydrate regenerated from viscose) may be taken as an example. This material is plasticized usually with a mixture of glycerine and water, the amount of glycerine being so regulated that when the "cellophane" has come to equilibrium with an ambient atmosphere having certain given conditions of temperature and humidity, the amount of water and glycerine is below the limit where the sheets become tacky and stick together when stacked. The degree of permissible tackiness of "cellophane" is dependent, among other factors, upon the thickness of the sheets, that is, under the same atmospheric conditions, a thick sheet can tolerate a larger percentage of glycerine than a thin sheet. This accounts for the relatively wide range in the percentage of glycerine found in the "cellophane" of the art. Thus with sheets varying in thickness of from approximately 0.0008 to 0.0016 of an inch, the glycerine content varies correspondingly from about 11% to 19% by weight.

The amount of plasticizer and/or softening agent varies also somewhat with the seasons of the year. Thus, for example, while "cellophane" sheets plasticized with 12% glycerine may exhibit no objectionable tackiness on a moderate day in spring, these sheets will stick together when stacked or rolled on a humid day in summer. On the other hand, on a cold and dry day in

winter or fall of the year, these sheets containing 12% glycerine will be under-plasticized and will cause trouble in hand and machine wrapping because of brittleness and lack of expansibility.

The above mentioned variations in the flexibility and expansibility of non-fibrous, homogeneous sheet materials give rise to numerous difficulties in the use of the materials. For example, brittleness on the one hand, or tackiness on the other will decrease the speed of manipulation of such materials in hand or machine wrapping, giving rise to inconvenience, waste and expense.

It is a general object of the invention to overcome the foregoing disadvantages and difficulties and to modify the surface characteristics of non-fibrous, flexible sheet materials so as to permit the use of a wider range of plasticizer and/or softening agent in such sheets so as to obtain a maximum of flexibility and expansibility under stretching with a minimum of tackiness and stickiness when stacked or rolled.

It is a further object of the invention to provide an improved process for treating non-fibrous, flexible sheet materials whereby there may be incorporated in the material a quantity of plasticizer and/or softening agent, substantially in excess of that normally present in said materials while, at the same time, obtaining a material less tacky than said normally plasticized materials.

It is a specific object of the invention to provide a process for treating non-fibrous, flexible sheet materials whereby to decrease the tendency of contiguous surfaces to stick together and adhere and to decrease the slipperiness of the surface to facilitate the winding up of the material into rolls and subsequent unrolling.

It is another specific object of the invention to provide a process for treating colloidal material swelling in water, whereby there may be incorporated in the material a quantity of softening agent in excess of that normally present in said material, and/or a quantity of absorbed moisture in excess of that normally present in said material, while at the same time obtaining a material less tacky than normal.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the product possessing the features, properties and the relation of elements which are exemplified in the following detailed disclosure and the scope of the application which will be indicated in the claims.

For a more complete understanding of the nature and objects of the invention, reference should be had to the accompanying drawing, in which:

Fig. 1 is a side elevation of one modification of an apparatus suitable for carrying out the process of the invention shown in association with part of a drying apparatus.

Fig. 2 is a top plan view of the distributing device of the apparatus shown in Fig. 1.

Fig. 3 is a side view in elevation of another apparatus suitable for carrying out the process of the invention, and

Fig. 4 is a sectional view of the apparatus of Fig. 3 taken along the lines 4—4 thereof looking in the direction of the arrows.

Generally speaking, the process of the invention comprises modifying the surface characteristics while improving the flexibility and expansibility of non-fibrous, relatively plastic sheet materials by depositing a multiplicity of fine particles of a non-fibrous, relatively plastic material, preferably of like character, upon the surface of said sheet materials, preferably while the surface is relatively plastic and/or tacky, and thereafter anchoring the comminuted material, preferably by embedding it in the surface of the sheet material.

The present process may form a part of the sheet manufacturing process, in which case the sheet material is plasticized with an amount of plasticizer in excess of that normally incorporated in the material, and thereafter there is applied to the surface of the sheet a substantially invisible deposit of comminuted material of like character. Preferably, a part of the excess plasticizer is removed before applying the comminuted material and thereafter a further part of the plasticizer is removed until the final treated product contains an amount of plasticizer just insufficient to cause the sheets to stick together when reeled upon a core, which amount will be greater than that normally present in the finished sheet materials under the prior art.

The term "plasticizer" as used herein, is intended to include all agents, both volatile and non-volatile, which act to soften and/or swell and/or flexibilize the sheet material to be treated, comprising agents present in the base sheet material such, for example, as water, residual solvents, polyhydric alcohols, camphor or camphor substitutes, and/or those agents present in a coating on the sheet material such, for example, as residual solvents, camphor or camphor substitutes, blown oils, etc. The process is applicable for treating various types of non-fibrous, homogeneous sheet materials, in particular, colloidal materials swelling in water such, for example, as cellulose hydrate, hydroxy alkyl derivatives of cellulose, gelatine, casein and the like; as well as cellulose derivatives such, for example, as cellulose acetate, cellulose nitrate, methyl cellulose and benzyl cellulose; also rubber and synthetic resins such, for example, as polymerized vinyl resins, "glyptal" resins and other plastic materials. Colloidal materials swelling in water are treated preferably while the material is slightly swollen as, for example, before the drying has been completed. The plastic and/or tacky surface condition aids materially in facilitating the adherence of the comminuted material to the sheet material, although it is to be understood that the use of adhesives in applying the comminuted material is not excluded.

The invention further contemplates the treatment of these sheet materials in a coated, as well

as in an uncoated condition. A sheet material of the type described may be coated first with a suitable composition for some particular purpose such as, for example, to render the sheet moisture-proof and then have applied over the coating a deposit of comminuted material which is of like character to the base sheet material.

The comminuted material suitable for use in the process is a non-fibrous, relatively plastic material, preferably a material of like character to the sheet material to which it is applied. For example, in modifying the surface characteristics of gelatine sheets, there is employed finely comminuted gelatine and for treating cellulose hydrate sheet material, there is employed comminuted cellulose hydrate. However, it is not essential that the comminuted material be of identical chemical nature to the sheet material to which it is applied provided it will swell and/or become gelatinous and adhere to the sheet material in the presence of the plasticizer and/or softening agent of the sheet material. For example, comminuted hydrocellulose has been found satisfactory for use in modifying the surface characteristics of all materials of the class described as "colloidal materials swelling in water". Accordingly, the expression "comminuted material of like character" used in the appended claims, is intended to cover the use of non-fibrous, relatively plastic material identical or similar in nature or composition to the base sheet material as well as such materials as are of like character in their tendency to be plasticized and/or softened and/or swollen by the plasticizer present in the sheet materials.

While there is a wide range permissible in the size of the particles of the comminuted material, it has been found preferable, in order to obtain the correlated results herein described without interfering with the generally accepted uses and properties of the sheet material, to employ material in the form of a powder, the particles of which are not substantially greater than those which will pass through a 100 mesh screen and may have a size corresponding to 200 mesh or more. The comminuted material is applied uniformly over one or both surfaces of the sheet material in a small amount, preferably so as to form a substantially invisible deposit which does not materially detract from the normal transparency of the material. In the now preferred practice of the process, satisfactory results are attained with comminuted material having particles of a size corresponding to from 100 to 200 mesh by distributing one pound uniformly over one surface of from 6,000 to 12,000 square yards of sheet material. The amount of the powder used may be varied somewhat from that given to take into account the thickness of the sheet material, the nature and amount of the plasticizer and/or softening agent, the season of the year and climatic conditions of storage and use of the treated material.

The comminuted material may be opaque, transparent and/or colored and in respect of these properties preferably should match the sheet material so as not to detract substantially from the normal appearance of the sheet material.

By way of illustrating the process of the invention, but not by way of limitation, there will be described two embodiments of an apparatus for distributing the comminuted material upon the sheet material, but it is to be understood that the apparatus is illustrative only and that other means than those described may be employed for

applying the comminuted material to the sheet material.

In the apparatus shown in Figs. 1 and 2, the distributing device may comprise a reservoir for the comminuted material and means to remove a small amount of the material from the reservoir and means to deposit the material removed on the sheet material. The reservoir may consist of, for example, a hopper 10 having converging side walls 11 and 12 which define an aperture 13 at one side thereof. The removing means may take the form of a roller 14 of suitable dimensions, disposed above and transverse of the web of material to be treated. The surface of the roller 14 is preferably smooth and highly polished and is disposed to brush across the aperture 13 of the hopper. To facilitate a uniform feeding of the material to the roller 14, the hopper 10 is provided with means for exerting pressure on the material, such as a weight 15 which rests on the top of the mass of comminuted material, the pressure of which weight may be augmented by a screw 16 passing through the top 17 of the hopper 10 and provided with a hand wheel 18. The depositing means may take the form of a rotatable brush 19 positioned forward of the aperture 13 and disposed so as to wipe the surface of the roller, thereby dislodging the particles and scattering them downwardly in the form of a cloud 20 which deposits on the sheet material.

Another suitable distributing apparatus is shown in Figs. 3 and 4, in which a roller 14' is provided with a rough surface such, for example, as a covering 21 of canvas. A hopper 10' may be disposed over the roller 14' so that the surface of the roller wipes across the aperture 13' at the bottom thereof. The rough surface of the canvas results in the comminuted material being deposited only in the interstices, thus providing a surprisingly uniform and regular distribution of the powder. The comminuted material deposited on the roller may be dislodged by a suitable air blast or a plurality of blasts provided by means of the nozzles 22 disposed forward of the aperture so as to direct a blast of air tangential of the roller 14', thereby forming a cloud 20' of the comminuted material.

For the purpose of illustrating the steps of the process there is shown in Fig. 1 part of a drying apparatus comprising a plurality of rollers disposed in two tiers, the rollers 23 of the upper tier being disposed to rotate in contact with the rollers 24 of the lower tier. These rollers may be heated interiorly or exteriorly by known means. The distributing apparatus above described is positioned above the drying apparatus in such a manner that the comminuted material dislodged from the conveyor as a fine dust 20 falls upon the surface of the web of sheet material 25 passing over the drying rollers.

By way of illustrating, but not by way of limiting the novel features of the invention, the surface characteristics, flexibility and expansibility of an endless web of cellophane, may be modified by applying to the material while its surface is in a relatively tacky condition, a very small quantity of comminuted cellulose hydrate or hydrocellulose, and thereafter drying the material, whereby the comminuted material is caused to adhere to the surface of the sheet material. The comminuted hydrocellulose may be prepared by treating cellulose hydrate or the like with a mineral acid, removing the excess acid by washing, and then drying and grinding the material until the particles have the desired size. While

the comminuted material usually will be anchored to the sheet material sufficiently merely by drying, the anchoring may be augmented by embedding the particles in the surface, preferably by pressing them into the surface during the drying operation. For example, with the apparatus of Fig. 1, the particles will be embedded in the surface as the sheet passes under the rollers 24 of the lower tier.

A sheet of cellulose hydrate having a thickness, for example, of 0.0012 of an inch which, untreated, cannot be plasticized with more than 13% to 14% of glycerine and from 6% to 8% of moisture in summer and from 16% to 17% of glycerine and from 6% to 8% of moisture in winter may, by treatment in the process of the invention, be plasticized so as to contain from 20% to 23% of glycerine and from 8% to 9% of moisture in summer and, if desired, with even larger amounts of glycerine in winter. Such treated material does not stick together when stacked or rolled and is more flexible and also more expansible when stretched than the same material plasticized to the maximum under the prior practice.

The product resulting from the novel process of the invention is not materially altered in general appearance. When a transparent material is treated with transparent particles of a size corresponding to 100 mesh or above, the deposit of comminuted material is practically invisible, the transparency of the sheet being substantially unimpaired. The treated material has, in addition, the same lustrous appearance. The treated material has the unusual and apparently contradictory characteristics of normal smoothness to the touch and a remarkable decrease in slipperiness. This apparent anomaly arises from the fact that the particles of comminuted material are, in the preferred practice, so minute in size and the quantity thereof present so small, that the treated sheet retains its original surface gloss and smoothness to the touch. However, the manner in which the particles are anchored to the surface appears to materially decrease the tendency of contiguous, treated surfaces to slide one upon another. This decreased slipperiness enables the treated material to be wound up in rolls less tightly than the untreated material, thereby preventing the formation of uneven pressure areas, especially the so-called "hard spots" in the roll and it permits very narrow widths of the material to be reeled into rolls of large diameters without the danger of telescoping.

The decreased slipperiness of the material is, further, in apparent contradiction to another remarkable characteristic of the treated material, which is its non-tackiness. In consequence of the substantial reduction of the tackiness of the surface, the treated material may be rolled and/or cut and stacked without the sheets sticking together. Moreover, since the comminuted material is by nature relatively soft and plastic, the particles thereof do not damage the blades of the apparatus used for sheeting and slitting the sheet materials. What is more important, the decreased tackiness permits the incorporation of an amount of plasticizer and/or softening agent in excess of that normally present in a particular material, thereby enabling the material to retain its flexibility for longer periods of time. Sheets of the treated material may be easily and rapidly removed from a stack, which greatly facilitates manipulation thereof by hand or by automatic feed devices in wrapping machines and the like. It appears probable that the various novel char-

acteristics exhibited by the treated material may be ascribed in part to the presence of the particles anchored on the surface, and in part to the pockets of air provided by them, which latter decrease the adherence by preventing the direct contact of large uninterrupted surface areas.

Since certain changes in carrying out the above process, and certain modifications in the article which embodies the invention may be made without departing from its scope, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

We claim:

1. A process for rendering less tacky plasticized transparent sheet material formed of colloidal material swelling in water comprising depositing on the surface of said material particles of comminuted transparent material of like character in an amount insufficient to detract substantially from the transparency and smoothness of the sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh, and embedding the comminuted material in the surface of said sheet material.

2. A process for rendering less tacky plasticized transparent sheet material formed of colloidal material swelling in water comprising depositing on the surface of said material, while the sheet material is in a swollen condition, particles of comminuted transparent material of like character in an amount insufficient to detract substantially from the transparency and smoothness of the sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh, subjecting the treated sheet to pressure to embed the comminuted material in the surface of the sheet material, and drying the sheet material.

3. A process for rendering less tacky plasticized transparent sheet material formed of cellulose hydrate comprising depositing on the surface of said material particles of comminuted transparent material of like character in an amount insufficient to detract substantially from the transparency and smoothness of the sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh, and embedding the comminuted material in the surface of said sheet material.

4. In a process for improving the flexibility of sheet material formed of colloidal material swelling in water comprising incorporating in said material a plasticizer in an amount just sufficient to render the sheet material tacky, depositing on the surface of said material particles of comminuted transparent material of like character in an amount insufficient to detract substantially from the transparency and smoothness of the sheet material and embedding the comminuted material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh, in the surface of said sheet material.

5. In a process for improving the flexibility of

transparent sheet material formed of cellulose hydrate, the steps comprising incorporating in said material a plasticizer in an amount just sufficient to render the sheet material tacky, depositing on the surface of said material particles of comminuted transparent material of like character in an amount insufficient to detract substantially from the transparency and smoothness of the sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh, and embedding the comminuted material in the surface of said sheet material.

6. In a process for improving the flexibility of transparent sheet material formed of cellulose hydrate, the steps comprising passing said material through an aqueous solution of a plasticizer for said material, removing water from said material until the surface is relatively tacky, depositing upon said tacky surface particles of comminuted cellulose hydrate in an amount insufficient to detract substantially from the transparency and smoothness of the sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh, drying said sheet material while subjecting the treated sheet to pressure to embed the comminuted material in the surface of the sheet material.

7. A process for rendering less tacky a plasticized sheet material formed of non-fibrous material comprising distributing over the surface of said material particles of comminuted material of like character in an amount insufficient to detract substantially from the normal appearance of the original sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky, the particles having a size of not substantially greater than 100 mesh.

8. As an article of manufacture, a plasticized sheet of non-fibrous material carrying on its surface particles of comminuted material of like character having a particle size of not substantially greater than 100 mesh, the comminuted material being present in an amount insufficient to detract substantially from the normal appearance of the original sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky.

9. As an article of manufacture, a plasticized transparent sheet of non-fibrous colloidal material swelling in water having embedded in its surface comminuted material of like character having a particle size of not substantially greater than 100 mesh, the comminuted material being present in an amount insufficient to detract substantially from the transparency of the original sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky.

10. As an article of manufacture, a plasticized sheet of cellulose hydrate carrying on its surface comminuted material of like character having a particle size of not substantially greater than 100 mesh, the comminuted material being present in an amount insufficient to detract substantially from the normal appearance of the original sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky.

11. As an article of manufacture, a plasticized transparent sheet of cellulose hydrate carrying on its surface comminuted material of like character having a particle size of from 100 to 200 mesh, the comminuted material being present in

an amount insufficient to detract substantially from the normal transparency of the original sheet material but sufficient to render contiguous surfaces of the sheet material non-tacky.

- 5 12. As an article of manufacture, a plasticized sheet of non-fibrous material carrying on its surface comminuted material of like character having a particle size of not substantially greater than 100 mesh, one pound of said comminuted material being distributed over one surface of 10 from 6,000 to 12,000 square yards of said sheet material.

13. As an article of manufacture, a plasticized transparent sheet of colloidal material swelling in water having anchored on its surface comminuted material of like character having a particle size of from 100 to 200 mesh, one pound of said comminuted material being distributed over one surface of from 6,000 to 12,000 square yards of said sheet material. 5

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