June 27, 1939. A. WALLACH 2,163,642

PROCESS AND APPARATUS FOR TREATING SHEET MATERIAL

Filed May 21, 1936

Fig. 1

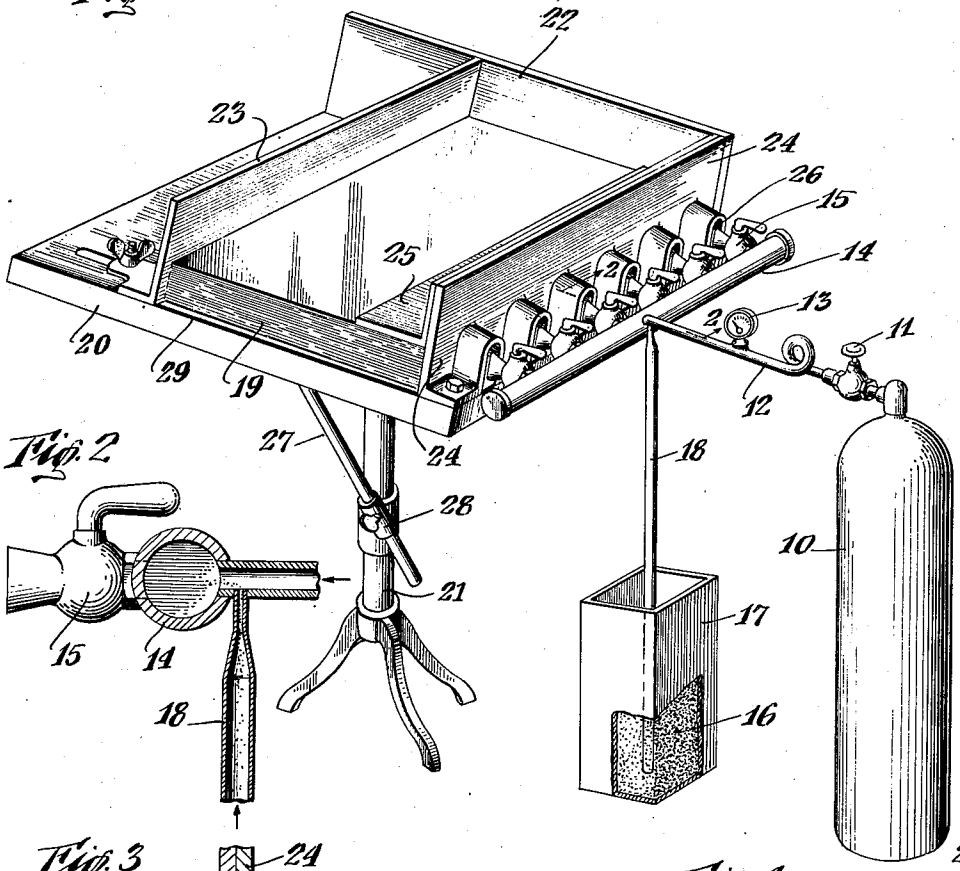
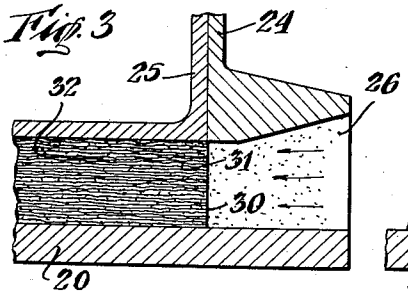


Fig. 2

Fig. 3



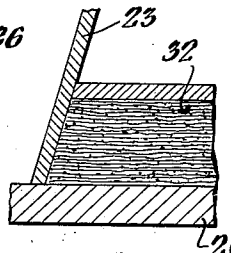
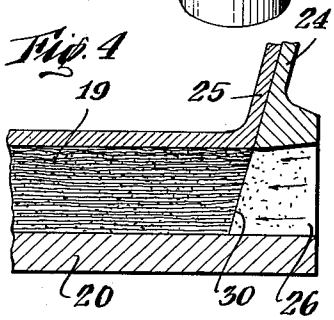


Fig. 4



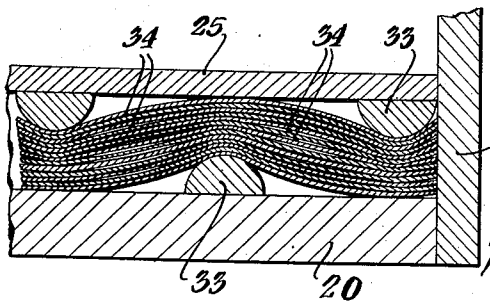


Fig. 5

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PROCESS AND APPARATUS FOR TREATING SHEET MATERIAL

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14 Claims. (Cl. 91—68)

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

Wrapping materials formed from non-fibrous, relatively plastic materials such as cellulose hydrate, cellulose derivatives, gelatin and synthetic resins are characterized by a high surface gloss, a high degree of transparency, a smooth surface and a relative expansibility. Sheets of such materials tend to stick together when tightly rolled or stacked, especially when stored under pressure or in atmosphere which varies with respect to temperature and humidity. The tackiness of such plasticized sheet materials is dependent, among other factors, upon (1) the thickness of the sheets, (2) the nature and amount of the plasticizer and (3) the temperature and relative humidity of the ambient atmosphere. Under the same atmospheric conditions, a thick sheet can tolerate a larger percentage of plasticizer than a thin sheet. Thus with sheets of cellulose hydrate 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 is varied with the seasons of the year. Cellulose hydrate sheets plasticized with 12% glycerine will exhibit no objectionable tackiness on a moderate day in spring, while these sheets will stick together on a humid day in summer and will be brittle on a cold and dry day in winter or fall. As the temperature and relative humidity increase, the tackiness of the sheets also increases.

The above mentioned factors taken together with the smoothness of the sheet materials give rise to numerous difficulties in the use of the materials. For example, when such material is cut into sheets and the sheets stacked, it frequently happens that the contiguous surfaces stick together to such an extent that it is difficult to separate the individual sheets from the stack. Occasionally after prolonged storage, particularly when under pressure, the sheets stick together to such an extent that the stack may become substantially a unitary block of the material so that this action is commonly referred to in the trade as "blocking". The sticking together of the sheets greatly decreases the speed of manipulating such materials in manual wrapping and renders it substantially impossible to use such sheets in automatic machines resulting in inconvenience, waste and expense.

It is a general object of the invention to prevent and/or decrease the "blocking" of stacked sheets of plasticized non-fibrous materials which have "blocked" together, whereby to facilitate the ready separation of individual sheets from the stack.

It is a further object of the invention to provide an improved process and apparatus for treating stacked sheets of non-fibrous, flexible materials to render the sheets insensitive, with regard to "blocking" tendencies, to material variations in the amount of plasticizer, the relative humidity and temperature of the ambient atmosphere and to conditions of storage.

It is a specific object of the invention to provide a process and apparatus for treating stacked sheets of non-fibrous, flexible materials whereby to decrease the tendency of contiguous surfaces of the sheets to stick together and to decrease the tackiness of the surfaces thereof to facilitate the use of the sheets in manual operations and in automatic machinery.

It is another object of the invention to provide a process and apparatus for reconditioning stacked sheets of non-fibrous materials simultaneously to improve their flexibility and to decrease the tendency of the sheets to stick together.

It is a further specific object of the invention to provide a stack of sheets of non-fibrous materials, the sheets being provided with means to facilitate their individual separation from the stack.

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

It has now been found that stacked sheets of flexible non-fibrous materials may be rendered insensitive (in a "blocking" sense) to variations in plasticizer, humidity, temperature and storage conditions generally by inserting between contiguous surfaces of the stacked sheets a small amount of a comminuted material. In the now preferred embodiment of the invention, the edges of the sheets in a face of a stack, either before or after they have become stuck together, are subjected to a blast of the gas containing a comminuted material. If the sheets are too brittle, the stack may be subjected simultaneously or separately to a gas consisting of or comprising a softening agent of the sheet material. Generally speaking, the apparatus of the invention consists of means to produce a current of a gas, such as air, means to disperse in the gas current a comminuted material and means to position a stack of sheets edgewise in the gas current.

The invention accordingly comprises a process having the several steps and the relation of one

or more of such steps with respect to each of the others, the apparatus embodying features of construction, combinations and arrangement of parts adapted to effect such steps, and the article which possesses the characteristics, properties and relation of elements, all as exemplified in the detailed disclosure hereinafter set forth and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a perspective view of one embodiment of the apparatus of the invention;

Fig. 2 is an enlarged sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a detailed view in section with parts broken away of a side elevation of a part of the apparatus of Fig. 1;

Fig. 4 is an enlarged sectional view with parts broken away of a second embodiment of a part of the apparatus which is illustrated in Fig. 3; and

Fig. 5 is an embodiment of the stack-holding means of the apparatus of Fig. 1.

The process and apparatus are applicable for treating stacked sheets of various non-fibrous materials, in particular, colloidal materials swelling in water such, for example, as cellulose hydrate, hydroxy-alkyl derivatives of cellulose, gelatin, 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 non-fibrous sheet materials. It is to be understood that such sheet materials may or may not contain suitable plasticizers, fillers, and may or may not be coated and/or impregnated with waterproofing and moistureproofing compositions.

For the comminuted material there may be employed an inorganic or organic solid, preferably one which is cheap, non-hygroscopic and relatively soft so as not to scratch the surface of the sheet materials, the parts of automatic machinery in which the treated sheets may be used, or articles wrapped therein. Suitable comminuted materials are inorganic substances such as barium sulphate, zinc oxide, talc, fuller's earth or organic substances such as flour, starch, dextrine, anthracene, alkali metal earth soaps, as well as comminuted material of like character to the sheet material such as cellulose hydrate, cellulose derivatives, gelatin, casein and the like. In the now preferred embodiment of the process, starch is employed since this material is cheap, relatively soft and non-gritty.

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 the surfaces of the sheet material in a very small amount, preferably in an amount insufficient materially to detract from the normal appearance of the sheet material.

Referring to the drawing, Fig. 1 is a perspective view of one embodiment of an apparatus suitable for carrying out the process, in which a current of a gas may be supplied from a cylinder 10 having a valve 11, the gas flowing through a conduit 12 having a pressure gauge 13 to a manifold 14 and to a plurality of outlet nozzles 15—15. The comminuted material 16 contained in a vessel 17 is sucked into the pipe 12 adjacent the manifold 14 or directly into the manifold through a pipe 18, the bottom end of which dips into the comminuted material. The stack 19 of sheets is supported upon a bed plate 20, preferably pivotally supported upon a stand 21. The bed plate is provided with a fixed back plate 22 and end plates 23 and 24. The end plate 23 is provided with conventional means to adjust its distance from the plate 24. A top plate 25 is preferably supported on the end plate 24 by conventional means (not shown) for adjusting its height from the bed plate 20 whereby to accommodate stacks of different heights therebetween. The wall of the end plate 24 is provided with a plurality of slit-like openings 26—26 corresponding in spacing and size to the several nozzles 15—15. The bed plate 20, being pivotally mounted on the stand 21, is provided with means such as a rod 27 sliding in a sleeve 28 to vary the inclination thereof. To allow the bed plate to be pivotally moved the pipe 18 should be formed of flexible hosing or have a flexible section therein and the pipe 12 should be provided with a suitable union or flexible section.

In carrying out the process, a stack 19 of sheets is placed on the bed plate 20 flush against the back plate 22 and end plate 24. The end plate 23 is then moved toward the plate 24 until the edges of the sheets in a face of the stack are firmly pressed thereagainst. If the sheets in the stack are firmly stuck together or "blocked", it is preferable first to knead or flex the stack across the straight edge 29 of the bed plate 20 so as to loosen up the stack.

To carry out the process with the apparatus of Fig. 1 the valve 11 is opened and the gas current causes the comminuted material 16 in the vessel 17 to be sucked through the pipe 18 and into the manifold 14 where it is dispersed in the gas. The gas containing the dispersed comminuted material passes from the nozzles 15—15 through the openings 26—26 against the edge 30 of the stack 19 of sheets, as shown in Fig. 3. The force of the current of gas causes the individual sheets 31 of the stack 19 to separate and the gas passing between the sheets deposits the particles 32 of the comminuted material on the surfaces of the sheets.

There is shown in Fig. 4 an embodiment of the apparatus of Fig. 1 in which there are provided means for forcing the stack 19 to assume the shape of a trapezoid so as to produce a progressive overlapping or offset of the successive sheets at the end as shown. For example, the end plates 23 and 24 are inclined at an angle, preferably less than 90°, with respect to the bed plate 20 so that the edge 30 of the stack which is positioned in the current of gas is overhanging as shown in Fig. 4. As a result of this novel arrangement, the entrance of the gas between the contiguous sheets is facilitated.

Another method of facilitating the separation of the sheets is to provide means to flex or corrugate the stack. For example, the bed plate 21 and the top plate 25 may be provided with alternating ribs 33 which function to flex the sheets one or more times, or corrugate the stack as

shown in Fig. 5. When the stack is thus flexed or corrugated, air spaces 34—34 are formed between adjacent sheets at intervals in the stack where the sheet changes direction intermediate of opposing ribs as shown in the drawing.

If the stacked sheet material is found to be dried out and brittle, the gas used for separating the sheets may advantageously consist of or comprise a known softening agent of the material and such treatment may be made simultaneously with or subsequent to the treatment with the comminuted material. For example, a suitable water aspirator is attached to the gas line 12 and there is formed in the manifold 14 a mixture of air, water vapor and comminuted material of non-hygroscopic character. This mixture is suitable for separating and simultaneously resoftening brittle sheets of regenerated cellulose. On the other hand, a mixture of air and alcohol vapor may be used with suitable comminuted material for separating and softening sheets of cellulose acetate.

For the compressed gas cylinder 10 there may be substituted an air compressor with a suitable motor to operate the same in a known manner. The gas pressure required to provide a suitable current will vary with the sheet material and the condition of the stack at the time of treatment. In the appended claims, the expression "gas current" is intended to cover a current of sufficient volume and force to cause a separation of the sheets in the stack being treated.

The stack may be slightly inclined from the horizontal or positioned substantially vertically in the supporting means and the lower edges of the sheets subjected to the blast of gas containing comminuted material by a suitable apparatus embodying the features of the invention. When disposed in this manner, the effect of gravity is partly overcome and the separation of the sheets facilitated. To further facilitate the separation of the sheets, the end plate 24 may be cut out at a point intermediate its ends so that the edges of the sheets in the stack may be riffled by hand while the gas current is played against the edges of the sheets. If desired, the end plate 23 may be suitably perforated to allow ready passage of the gas through the stack or the openings 26—26 may be placed in the back plate 22, particularly when the stack is to be positioned substantially vertically.

The product resulting from the novel process of the invention is not materially altered in its general appearance. When a transparent material is treated with particles of a size corresponding to 100 mesh or above, the deposit of comminuted material is practically invisible, the transparency and lustre of the sheet being substantially unimpaired. The sheets in the treated stack are free-flowing and may be separated easily by hand or automatic devices.

It appears probable that the various novel characteristics 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 smooth surface areas.

Since certain changes may be made in carrying out the above process and in the article, and modifications effected in the apparatus for practicing the principle thereof, without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A process for treating a stack of sheet materials to render the individual sheets separable comprising depositing from a gaseous dispersion and between contiguous surfaces of the sheets while in said stack a small amount of comminuted solid material.

2. A process for treating a stack of sheet materials to render the individual sheets separable comprising inserting between contiguous surfaces of the sheets while stacked a thin layer of gas carrying a small amount of comminuted solid material.

3. A process for treating a stack of sheet materials to render the individual sheets separable comprising positioning a stack of sheets edgewise in a current of a gas containing a comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

4. A process for treating a stack of sheet materials to render the individual sheets separable comprising subjecting edges of sheets in a face of a stack to a current of a gas containing comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

5. A process for treating a stack of sheet materials to render the individual sheets separable comprising separating the individual sheets of a stack of sheets by means of a blast or air, and blowing in and depositing between the contiguous surfaces of the sheets a small amount of comminuted solid material.

6. A process for treating a stack of sheet materials to render the individual sheets separable comprising blowing in and depositing between contiguous surfaces of the sheets while in said stack a multiplicity of particles of comminuted solid material in an amount insufficient to detract substantially from the normal appearance of the individual sheets.

7. A process for treating a stack of sheet materials to render the individual sheets separable comprising flexing the stack of sheets and positioning the stack of sheets edgewise in a current of a gas containing comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

8. A process for treating a stack of sheet materials to render the individual sheets separable comprising kneading the stack of sheets until the edges of the sheets are slightly out of line at one face of the stack and subjecting the edges of the sheets in said face to a current of gas containing a small amount of comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

9. A process for treating a stack of sheet materials to render the individual sheets separable comprising flexing the stack to separate the edges of the sheets in a face of the stack in at least one place and subjecting said face at said place to a current of gas containing comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

10. A process for treating a stack of sheet materials to render the individual sheets separable comprising corrugating the stack and subjecting the edges of the sheets in a face of the stack which is transverse said corrugations to a current

of a gas containing comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

11. A process for treating a stack of sheet materials to render the individual sheets separable comprising subjecting edges of sheets in a face of a stack to a current of a gas containing comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material and riffling the edges exposed to the current.

12. A process for treating a stack of sheet materials to render the individual sheets separable comprising disposing the stack on an edge-face and subjecting the lower edges of the sheets to a current of a gas containing comminuted solid material to deposit between contiguous surfaces of the sheets a small amount of said comminuted material.

13. As an article of manufacture, a stack of flexible sheets of plasticized non-fibrous material and particles of a comminuted solid material distributed between the individual sheets to render the sheets readily separable from each other, the comminuted material being of such particle size and present in such an amount as not to detract substantially from the normal appearance of the sheet material.

14. As an article of manufacture, a stack of flexible sheets of plasticized non-fibrous material and thin layers of a gas between the contiguous surfaces of said sheets and particles of a comminuted solid material distributed between the individual sheets to render the sheets readily separable from each other, the comminuted material being of such particle size and present in such an amount as not to detract substantially from the normal appearance of the sheet material.

ANDRÉ WALLACH.