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METHOD OF PRODUCING PAPER HAVING A
MIRROR-LIKE LUSTER

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The present invention relates to a method of producing papers having a glossy surface and, more particularly, to a method of producing paper sheets, strips or webs having a highly polished surface of mirror-like luster.

Heretofore, a number of different methods have been used or proposed for producing papers having a glossy or glazed surface. One of these conventional methods included the satining or calendering of the paper with smooth steel rollers under considerable pressure. Although the satining provided a fairly good polish, it failed to produce a high polish of mirror-like luster. Another conventional method was frictional calendering which provided a better and glossier surface than the former, but likewise failed to give a mirror-like luster. The highest luster obtainable was usually provided by means of the so-called stone polishing process, but even this process was unable to provide anything which approaches a mirror-like luster or polish.

It is well known by those skilled in the art that an important difference exists between high luster and mirror-like luster. Thus, a surface having a mirror-like luster will reflect an image with a clear and sharp definition and edge where as a surface having only high luster is incapable of reflecting such a clear cut image but can only reflect a blurred, indefinite and unclear image. When deciding whether a surface has a high luster or mirror-like luster, the circumstance of the image being distorted by curvatures is of no importance because the principal consideration is whether the reflected image has a sharp definition, or not. It is well known from experience that it is impossible to obtain a mirror-like luster on the surface of a paper even by applying very great rolling pressure to paper surfaces. Apparently this is due to the inherent elasticity of paper sheets or strips. The particles on the surface of the paper, even very small ones, after having passed the point or line of high pressure, will rise again from the plane of the paper surface to a lesser or greater extent depending upon their elasticity, etc. This circumstance makes the production of paper with a mirror-like luster practically impossible because deviations from the ideal plane of about $\frac{1}{4000}$ mm. and less tend to produce a diffuse reflection and to exclude the possibility of a sharp and exact definition characteristic of mirror-like surfaces.

In the case of rigid or non-elastic materials, mirror-like luster is usually provided by means of polishing and most of the conventional mirrors and reflecting metallic surfaces are obtained in

this manner. Materials which are not capable of being directly polished to a mirror-like luster are usually treated by means of indirect processes involving the use of lacquers and like substances. According to these indirect methods, a base or bottom coating is first provided on the treated surface and subsequently this base or coating is polished to a high luster. A coating of lacquer uniformly applied to this base or coating will display a mirror-like luster. This indirect method, however, will not work when applied to an unpolished surface, such as that of a paper strip, web or sheet. Lacquers applied on the surface of paper although capable of giving high luster will never give a mirror-like luster. Deviations from the ideal plane, although extremely small, will cause the production of diffuse light which disturbs or destroys the sharpness of the reflected image. It has been suggested to polish the surface of paper sheets, strips, or webs, but this has been connected with insurmountable practical difficulties and has been hardly possible. Although the art was confronted with a vexatious and outstanding problem and although experts in the art were endeavoring to solve the problem, none of the prior attempts has been wholly practical, satisfactory or successful.

I have discovered a method which solves the outstanding problem and which makes it possible to produce paper having a mirror-luster surface in a remarkably simple manner, especially when carried out on an industrial scale to produce commercially acceptable products.

It is an object of the present invention to provide an improved method of producing paper sheets, strips, webs and the like with a mirror-like luster or finish on the surface thereof.

It is another object of the present invention to provide a simple, quick and inexpensive method of producing on an industrial scale glossy papers having a high or mirror-like luster heretofore unobtainable commercially.

The invention also contemplates a new article of manufacture comprising a paper sheet, web or strip having a mirror-like luster or finish.

Other objects and advantages of the present invention will become apparent from the following description of preferred embodiments of the invention.

Broadly stated, according to the principles of my invention I provide an intermediate or cushioning layer on the surface or base of paper. This intermediate cushioning or leveling layer has the property of being pliable under the ap-

plication of moderate heat but retaining its form under normal conditions. On this intermediate layer, I apply a top layer of a lacquer which is not affected especially not fused by the temporary conditions of manufacture, particularly moderate application of heat to be used for the intermediate or cushioning layer. I have found that the application of moderate heat and of light and yielding contact pressure to the lacquered surface by a member having a completely smooth and mirror-like surface will cause said intermediate layer to soften and to conform to the small elevations and depressions of the treated surface and will provide a completely plane surface conforming to the perfect surface of the polished roller or plate whereby the layer of lacquer, which is of naturally glossy character, in combination with the intermediate cushioning or leveling layer serving as a completely smooth base will provide the desired mirror-like luster and finish and will permanently retain such finish after the intermediate layer has completely solidified. The finished product is an article of manufacture comprising a fibrous base or body portion, an intermediate cushioning or leveling layer of relatively low melting point having its lower side united with the surface of said body portion and conforming to the irregularities thereof and having a perfectly even upper side provided with a top layer of a lacquer which remains unchanged at the melting temperature of the intermediate layer.

In carrying out the invention on a practical scale, I apply an intermediate cushioning or leveling layer to the surface of the base. This layer has the property of melting or at least becoming softened or pliable when heated to a moderate temperature, such as about 100° C. or more. On this intermediate and fusible layer, I provide a suitable, uniform layer of lacquer, such as a cellulose ester which is non-melting or not affected at all by the temperatures at which the intermediate layer melts or becomes plastic. After drying the top layer of lacquer, I pass the strip, web or sheet so treated in contact with a heated roller having a mirror-like finish and bring the same in light and yielding contact with said roller by means, for example, of a soft rubber roller. In this manner, the intermediate and fusible cushioning layer will be partly or completely melted or softened and will level all irregularities or unevennesses which are present. The non-melting top layer of lacquer will, of course, completely conform to the mirror-like surface of the heated roller and, at the same time, will act as a protective layer for the melted intermediate cushioning layer and will prevent its sticking to the heated roller. After leaving the heated roller, the softened or melted intermediate layer solidifies but retains the form imparted to it by the roller whereby the top lacquer layer or skin has been brought into the desired ideal plane and displays a mirror-like luster.

I have found that a great variety of materials may be used for the production of the improved paper with a mirror-like luster. Thus, for the intermediate cushioning or leveling layer waxes, resins, rubber and the like or generally materials which melt and become plastic, pliable or softened at moderate temperatures may be used. Mixtures of the foregoing or similar materials are preferably used. By providing suitable mixtures definite, selected or preferred melting or softening temperatures can easily be obtained. Glue or gelatin with additions of glycerin or

grape sugar may likewise be used as the intermediate layer.

For the top layer I prefer to use a cellulose ester although a great number of other suitable lacquers may be used which remain unchanged at the treating temperature necessary for making the intermediate cushioning layer pliable or plastic.

Although any appropriate equipment may be used for carrying the present invention into practice, I have discovered that it is preferable to use an apparatus comprising a pair of rotatable rollers arranged in parallel spaced relationship to each other. One of the rollers is made of soft rubber or is provided with a soft rubber surface. The paper strip or sheet under treatment is usually advanced by the said rubber roller. The other roller is preferably made of highly polished metal, such as steel, having a surface with mirror-like finish and being provided with means for heating, such as steam, gas or the like as those skilled in the art will readily understand. This heatable roller is arranged to exert a moderate and adjustable pressure on the material held against said rubber roller. The distance is so adjusted by means of setting screws that the paper surface is only in light and yielding contact with the heated roller but excessive compression, deterioration or destruction of the intermediate cushioning or leveling layer is prevented. Since the finished product exactly conforms to and copies the surface of the heated roller, it is possible to provide markings or designs engraved into or raised on the surface of the heated roller whereby the designs are exactly reproduced on the paper surface and interrupt the continuity of the mirror-like surface. The finished product with or without the markings referred to may be used for a variety of purposes for providing high quality papers of the so-called stained, marbled or glazed character in all places where an attractive mirror-like surface is desirable. For instance, my improved paper may be employed for fancy papers, for wrapping papers and so on.

For the purpose of giving those skilled in the art a better understanding of my invention, the following illustrative example is given:

Example

A mixture of about 60 parts by weight of glue or gelatin, 40 parts by weight of glycerin is prepared in water and if desired, a suitable coloring agent is added. The resulting product has after drying a melting point of approximately 80-100° C. and is applied as a cushioning layer in a heated or dissolved condition by means of coating to a plain paper as usual for coating purposes. The cushioning or leveling layer is applied in the amount of about 0.010 kg. to 0.070 kg. per square meter of treated surface.

On top of the cushioning layer a layer of cellulose ester lacquer dissolved in ethyl acetate is provided. The finished lacquer layer is applied in a quantity of about 0.001 kg. to 0.010 kg. dry product per square meter. The paper provided with the cushioning and with the lacquer layer is passed without applying any pressure between the finishing roller heated to a temperature of about 80° C. to about 100° C. and a soft rubber roller. The obtained product is highly glossy and has a mirror-like luster.

It will be observed that the present invention provides a novel and improved method of treat-

ing the surface of papers and providing a mirror-like luster heretofore unattained.

It will be also noted that the invention provides a simple, quick and inexpensive method of providing paper surfaces or paper sheets, strips or the like with a novel glossy surface approaching or equaling the luster of a mirror or of a highly polished metallic surface.

It will be noted that the present invention teaches the preparation of a new article of manufacture, to wit: of a paper sheet, strip, web or the like having a novel, attractive, and mirror-like appearance.

Although the present invention has been described in connection with certain preferred embodiments thereof, many variations and modifications may be resorted to by those skilled in the art without departing from the scope and spirit of the invention as disclosed in the present specification and defined by the appended claims.

I claim:—

1. The method of producing paper having a glossy surface and mirror-like luster which comprises coating a fibrous base with a readily fusible material to form a cushioning and leveling layer thereon, providing a top layer of heat resisting lacquer on said cushioning layer, drying said lacquer, and, subsequently bringing the pretreated product in light and yielding contact with a surface having a mirror-like finish and heated to a temperature not higher than approximately the temperature of fusion of said cushioning and leveling layer whereby one face of said cushioning and leveling layer will conform to the irregularities of said base and the other face of said layer will conform to the mirror-like surface of said contact surface and will cooperate with said top layer of lacquer to provide a permanent mirror-like luster.

2. The method of producing paper having a glossy surface and mirror-like luster which comprises providing an intermediate cushioning and leveling layer on a fibrous base said layer being constituted of a material having a relatively low softening temperature and containing at least one of the substances of the group consisting of waxes, resins, rubber, gelatin and glue, applying on top of said cushioning and leveling layer a layer of lacquer adapted to remain practically

unchanged by the softening temperature of said cushioning layer, and bringing the pre-treated surface in light and yielding contact with a cylindrical surface of mirror-like finish, and heated to the temperature of fusion of said cushioning layer whereby one face of said cushioning layer will conform to the irregularities of said base and the other face of said layer will conform to the mirror-like surface of said roller and will co-operate with said top layer of lacquer to provide a permanent mirror-like luster.

3. The method of producing paper having a glossy mirror-like luster which comprises polishing the surface of a fibrous sheet, forming a fusible cushioning and leveling intermediate layer on said sheet, said layer being constituted of a material containing at least one substance of the group consisting of waxes, resins, rubber, gelatin and glue, applying a top layer of a lacquer of cellulosic character on said intermediate layer, and bringing the pre-treated sheet in light and yielding contact, with a surface having a mirror-like finish at a temperature at which said intermediate layer becomes pliable and conforms both to the irregular surface of said fibrous sheet and to the mirror-like surface of said contact surface whereby a smooth, mirror-like surface is imparted to said top layer and is permanently retained after cooling of said intermediate layer.

4. The method of producing paper having a glossy surface and mirror-like luster which comprises polishing the surface of a paper sheet, forming a fusible cushioning and leveling intermediate layer on said sheet, said layer being constituted of a material containing at least one substance of the group consisting of waxes, resins, rubber, gelatin and glue, applying a top layer of cellulose ester on said intermediate layer and subsequently bringing the pretreated sheet in light and yielding contact with a surface having a mirror-like finish at a temperature at which said intermediate layer becomes pliable and conforms both to the irregular surface of said paper sheet and to the mirror-like surface of said roller whereby a smooth, mirror-like surface is imparted to said top layer and is permanently retained after cooling of said intermediate layer.

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