

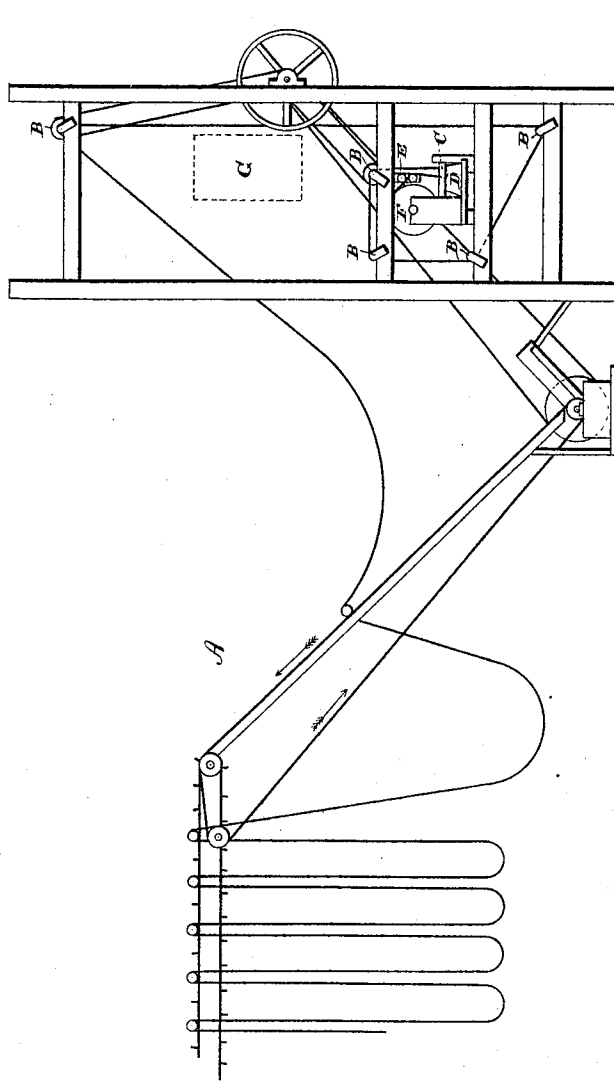
(No Model.)

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PROCESS OF COATING PHOTOGRAPHIC PAPER.

No. 370,111.

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# UNITED STATES PATENT OFFICE.

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## PROCESS OF COATING PHOTOGRAPHIC PAPER.

SPECIFICATION forming part of Letters Patent No. 370,111, dated September 20, 1887.

Original application filed March 5, 1887, Serial No. 229,847. Divided and this application filed August 20, 1887. Serial No. 247,492. (No model.)

*To all whom it may concern:*

Be it known that we, WILLIAM HALL WALKER, a citizen of the United States, of Rochester, Monroe county, New York, and temporarily residing in London, England, and GEORGE EASTMAN, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Processes of Coating Photographic Paper; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

This application is filed as a division of our prior application, No. 229,847, (the latter a divisional application of No. 146,449,) and is designed to cover the method of manipulating the paper or web during and after the coating has been applied, as set forth in said application No. 229,847, for the purpose of drying the paper and finishing the article by a continuous process. The said application No. 229,847 describes and is designed to cover the improvement in the art of coating paper or other flexible supporting material with a thin coating of a material possessing a setting or stiffening property and preserving the uniformity of the coating by maintaining the web in motion while the coating is setting or stiffening sufficiently to prevent running.

Our present invention, although founded upon and including the process claimed in our before-mentioned application for maintaining uniformity of the coating, embraces as an additional step the method or mode of manipulating the coated web after the coating has set or stiffened, whereby as rapidly as the coating sets or stiffens sufficiently to prevent running the coated web is delivered or deposited upon a frame or support to dry. It also comprehends the application to the coated web, while in motion, of a cooling medium for expediting the setting or stiffening of the coating, all as hereinafter more fully described, and pointed out in the claims.

Since the introduction of the article known as "bromide paper" for photographic positives and negatives numerous attempts have been made to devise a practicable method of manufacturing the material on a large scale

and at less expense both in time and material; but until our present invention no material progress had been made and the manufacture was conducted by what may be termed the "original processes"—that is to say, either by laying the sensitized material on the paper with the brushes or the more common method of passing the strip of paper around rollers, uniting the ends of the strip to form an endless band, and by the rotation of the rollers causing the band to travel in contact with a body of emulsion until the entire surface had received a coating, when it was suspended or left hanging until dried.

A moment's consideration of the nature of the sensitized material, the conditions under which it is applied, and the changes to which the paper is subjected will serve to show why the ordinary processes of coating and the machinery employed are incompetent to perform the operations and at the same time preserve the necessary conditions.

The sensitized emulsion, as ordinarily compounded, contains as the sensitive medium silver salts dissolved or held suspended in a mixture of water and gelatine, the latter serving as the vehicle for carrying and holding the sensitive material upon the paper. The silver salts are a valuable product; hence it is desirable that the minimum quantity capable of producing good work should be employed, and for that and other reasons only sufficient gelatine is mixed in the emulsion to produce, when applied to the paper, a film layer of just sufficient depth to retain the desired or requisite quantity of the sensitizing medium. As is obvious, the layer of film or emulsion deposited on the paper must be as free from spots and irregularities as possible; hence any treatment of the paper or coating before, during, or after the emulsion is applied which will produce or favor the formation of spots, streaks, or irregularities in the surface or thickness of film will result in the production of defective and unsalable paper, involving the loss of much valuable time, labor, and material. It must also be remembered that the emulsion is in a liquid condition when applied to the surface of the paper, that the paper becomes saturated by the water contained in the mixture, that no opportunity is afforded for a critical examination of the coating, nor can the defects in its

surface be removed or remedied after the gelatine has once set, and that the entire process has necessarily to be conducted in a photographic dark-room; hence if the finished article contains the irregularities and inequalities mentioned, they cannot readily be discovered or detected even by a critical examination—the coating is so extremely thin—until the final test—actual use—has been applied, and then, and not before, can the merchantable and practical value of the material be ascertained. It will be readily understood, therefore, why the ordinary processes employed for coating cloth, paper, and other materials with paint, glue, paraffine, and other substances and compounds not requiring so even and regular a surface as photographic paper, whose irregularities are measured not by instruments, but by the results produced by the action of light alone—why said processes and machines have not and cannot, as ordinarily worked, be used in the manufacture of photographic paper.

As before stated, notwithstanding the many attempts made to produce a successful article of bromide-paper by a cheaper and more practicable method, the only process by which it was generally understood it could be made successfully, and the only one in practical use at the time of our invention, was that in which a belt or band of paper with its ends united was caused to pass through a bath of emulsion, and when the band had been drawn through the liquid and the coating applied it was either raised out of the bath and allowed to hang until dry or, what is the same thing, was removed to a drying-frame and suspended thereon.

The use of brushes for applying the coating, although attempted, has not proved successful, owing to the extreme difficulty experienced in applying the emulsion evenly throughout the entire surface of the paper. After many unsuccessful attempts and the expenditure of much time, labor, and money, we have succeeded in discovering a method of manipulation whereby, by a continuous process, we are enabled to produce a commercial article of bromide paper expeditiously and cheaply, in sheets of any desired dimensions, and with the minimum of waste.

Our improvement relates more particularly to the treatment of the paper after the coating has been applied, and consists, generally stated, in so conducting the operation that after the paper has been supplied with a thin and uniform coating of the emulsion, and while the layer or film is still in a fluid state, the coated web shall, while under sufficient tension to maintain its surface flat, be drawn or moved continuously in the same direction until the gelatine in the coating has set, after which and as rapidly as the web is delivered it is hung in loops or deposited upon a frame, where it is allowed to remain until the paper has thoroughly dried.

Various mechanical contrivances may be em-

ployed in practicing our improvement—such, for example, as those described in the applications of George Eastman, Serial Nos. 224,189 and 228,746; but the preferred form, construction, and arrangement is that described in our before-mentioned application, No. 146,449, patented No. 358,848, of which patented machine the drawing is a representation, in which the figure is a side elevation of the machine.

The letter A designates the hang-up or drying frame; B, the supporting or carrying rollers; C, the immersion-roller; D, the trough or receptacle for the liquid emulsion or coating material; E, the paper-feeding rolls, and F the roll of paper. For a more full description of the mechanism reference may be had to the before-mentioned patent.

The dotted lines G represent a tank or receptacle containing a cooling or refrigerating mixture, and serve merely to illustrate one mode of cooling the coated web, as hereinafter described.

It is of the utmost importance in practicing our improved process that the paper (which is drawn from a roll of any desired dimensions) should receive an even coating of the fluid emulsion, and we have found that this can best be secured by causing the strip or web to pass into and emerge at an angle from a layer or body of the fluid emulsion, so that the paper as it rises from the level surface of the emulsion as adheres to its surface, the surplus flowing back into the receptacle. The paper as it passes through the emulsion takes up a large quantity of water, which acts to expand and soften the web; hence it becomes necessary to apply sufficient tension to draw it flat over the rollers or other supporting devices. The tension on the paper must be, however, so regulated that while serving to maintain the web flat and move it at a uniform speed it shall not produce wrinkles by the unequal strain upon the now weakened and expanded paper, for if such wrinkles or other irregularities in the surface occur the still fluid coating will run irregularly and form in streaks on the paper. It is to be observed, moreover, that after the coating has been evenly applied to the web, and while the latter, bearing the fluid coating, is continued in motion to preserve and maintain its uniformity, it is essential that the coated face be unobstructed—that is to say, it must be held and maintained out of contact with any foreign substance, such as pressing-rolls, scrapers, or other devices, which, if permitted to so much as touch the coating, would defeat the purpose of the process by destroying the uniform character of the film and render the latter unfit for photographic purposes.

The rate of motion and distance intervening between the coating devices and the hang-up frame vary with the state of the atmosphere and the quality of the emulsion. Ordinarily, in using a machine such as described in our application No. 146,449, the rollers are driven

at such speed as will advance the paper twenty feet a minute, and with the temperature of the room maintained at about 65° Fahrenheit the hang-up is located at about thirty feet distance—that is to say, the paper is maintained in motion for about one to two minutes after leaving the coating-bath before it is deposited upon the slat of the drying-frame. The time and distance must of course be adjusted and regulated according to the temperature and state of the atmosphere, and, if desired, artificial cooling and drying devices may be employed; but under all circumstances, in order to prevent blemishes when practicing the continuous process, the coated web must be kept in motion and flat until the gelatine has set, so as to be incapable of further movement upon the surface of the paper, and when this stage has been reached, but not before, can it be suspended in loops upon the drying-frame, and remain there until the moisture has evaporated without injury to the coating. The movement of the web after the coating material has been evenly applied, and which is continued until the coating has set or stiffened, so as to prevent running, is a progressive movement, the travel being at all times forward; but in order that the flow of the material may be regulated and the uniformity of the coating maintained it is desirable that the direction—*i. e.*, the angle of inclination—of the web during its progressive movement should at times be reversed or altered, so that at one point it will travel upward and subsequently downward, or vice versa, thereby arresting or changing the direction of flow, if any takes place, of the liquid coating upon the traveling web. Thus, in the machine illustrated, the web as it emerges from the coating device is caused to move first upward, then horizontally, downward, horizontally, and again upward to the delivery-roller.

Under certain circumstances—as when it is desired to use a thin emulsion or in warm weather—the setting of the coated film may be facilitated by reducing its temperature as it passes from the coating apparatus to the hang-up machine. This artificial cooling of the coated web may be accomplished by the use of a current of air or by causing the web to pass over a surface the temperature of which is kept down as by a current of cold air, water, or a cooling mixture or compound. A fan-blower or other suitable device may be employed to produce a current of air, which is cooled by passing over ice or in any other preferred manner, the air being carefully strained from dust.

It is obvious that the process herein described is adapted to the coating of webs or strips of fabric with a surface-coating of any material which has a tendency to run and streak after its application and which possesses the property of setting or stiffening gradually while the web is maintained in motion to preserve the uniform surface of the coating.

It will be observed that according to our present invention three distinct operations are required to produce the finished article—first, the application of the coating material; second, maintaining the web in motion until the coating thereon has set or stiffened sufficiently to prevent running; and, third, depositing the coated web as rapidly as the coating sets or stiffens upon a support to dry; and, further, that all those operations are performed simultaneously, but upon different portions of the same continuous web or band of paper, so that while at one point in the length of the traveling web the coating is being applied, at another it is setting or stiffening, and at still another and more advanced stage is delivered or deposited upon the drying-frame.

We claim—

1. The herein-described process of coating a continuous web of fabric with a uniform layer of sensitive gelatino-argentic emulsion, consisting in applying the emulsion to one side of the web as it is passed through the coating device, in artificially cooling the coated web, in keeping the coated web in continuous motion and the coated surface removed from contact with obstructing devices until it is set, and, finally, in delivering the web to a suitable rack or frame to dry, substantially as described.

2. The herein-described process of coating a continuous web of paper with a uniform layer of sensitive gelatino-argentic emulsion, consisting in applying the emulsion to the lower side of the web as it is passed through the coating device, in carrying the coated web on suitable moving supports around the coating apparatus and keeping it continuously in motion and the coated surface unobstructed until the gelatine has set or stiffened sufficiently to prevent flowing, and in subsequently delivering the coated web to a suitable drying frame or rack, substantially as and for the purpose set forth.

3. The herein-described continuous process of producing gelatino-argentic fabric for photographic reproductions, consisting in applying in a suitable non-actinic light to a moving continuous web of fabric a uniform layer of sensitive argentic-fluid emulsion, keeping said web in motion and the coated side unobstructed until the coated gelatine is set or stiffened sufficiently to prevent flowing, and, finally, while the web is in motion and the coating being applied, depositing that part of the web on which the coating has set or stiffened at rest with relation to its supports to dry.

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