

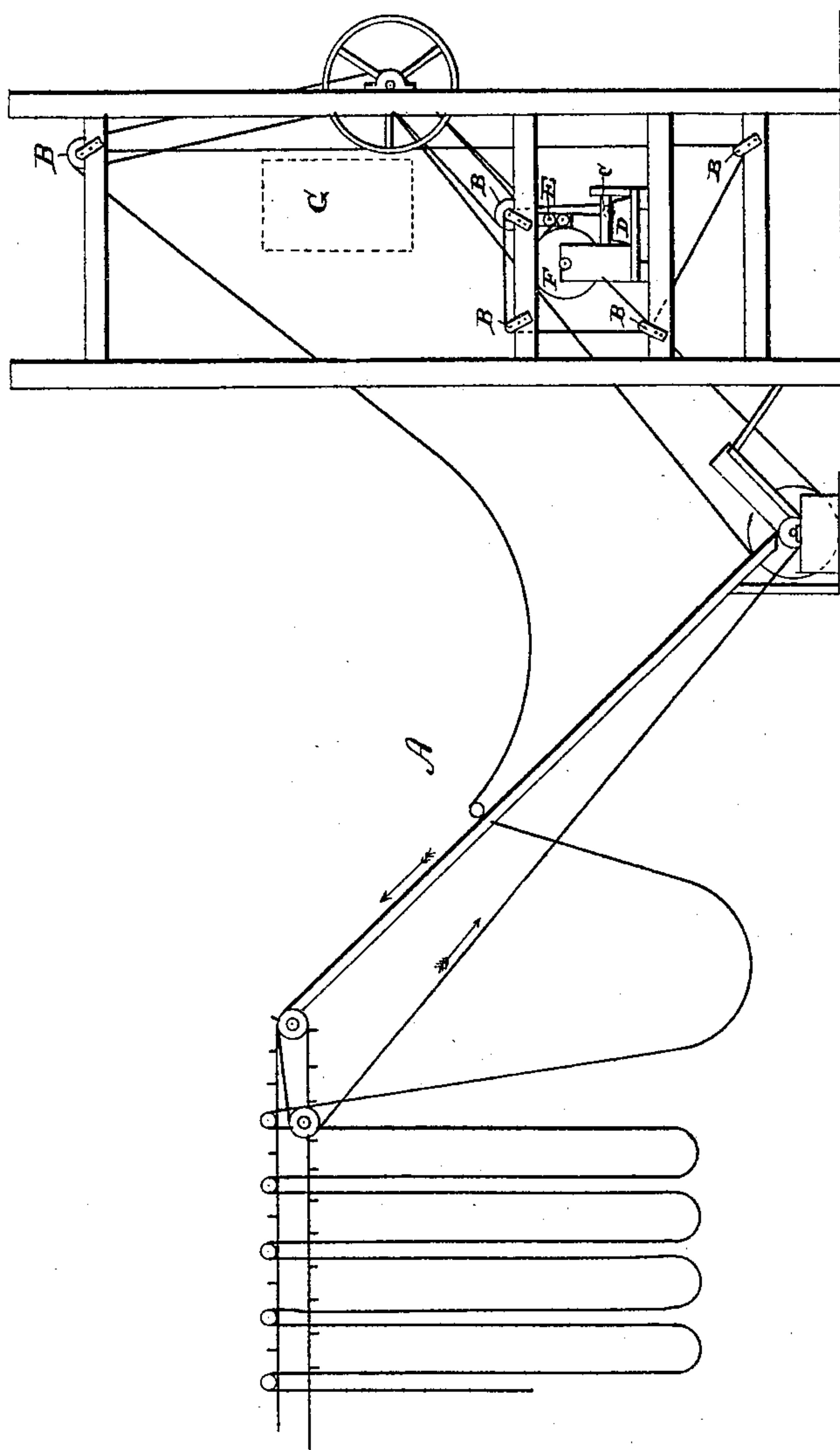
(No Model.)

W. H. WALKER & G. EASTMAN.

PROCESS OF COATING PHOTOGRAPHIC PAPER.

No. 370,110.

Patented Sept. 20, 1887.



Witnesses.

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# UNITED STATES PATENT OFFICE.

WILLIAM HALL WALKER AND GEORGE EASTMAN, OF ROCHESTER, NEW YORK, ASSIGNORS TO THE EASTMAN DRY PLATE AND FILM COMPANY, OF SAME PLACE.

## PROCESS OF COATING PHOTOGRAPHIC PAPER.

SPECIFICATION forming part of Letters Patent No. 370,110, dated September 20, 1887.

Original application filed October 25, 1884, Serial No. 146,449. Divided and this application filed March 5, 1887. Serial No. 229,847. (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, temporarily residing at 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.

This application is filed as a division of our prior application, No. 146,449, (patented March 8, 1887, No. 358,848,) and is designed to cover the improvement in the art of coating paper or other flexible supporting material with a uniform coating of sensitized emulsion, said improvement being described and set forth in the before-mentioned application, but not limited in practice to the mechanism there shown.

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 brushes or the more common method of passing a strip of paper around rollers, uniting the ends of the strips 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 com-

pounded 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 or layer of just sufficient depth to retain the desired or requisite quantity of the sensitizing medium. As is obvious, the layer or film of 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 the 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 readily be 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 re-



sults 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.

5 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 successfully  
10 made, 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  
15 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.

20 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.

25 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  
30 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  
35 has been applied; and it 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  
40 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,  
45 it is hung in loops upon a frame, where it is allowed to remain until the paper has been thoroughly dried.

Various mechanical contrivances may be employed in practicing our improvement—such,  
50 for example, as those described in the applications of George Eastman, Nos. 224,189 and 228,746; but the preferred form, construction, and arrangement are described in our before-mentioned application, No. 146,449, patented  
55 No. 358,848, of which patented machine the accompanying 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  
60 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 our  
65 before-mentioned patent.

The dotted lines G represent a tank or re-

ceptacle containing a cooling or refrigerating mixture, and serve merely to illustrate one mode of cooling the coated web, as hereinafter 70 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 75 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 80 the liquid may carry only so much of the emulsion as adheres to its surface, the surplus flowing back into the receptacle. It is to be observed, moreover, that after the coating has been evenly applied to the web, and while the 85 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 90 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 95 photographic purposes. 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 100 other supporting devices. The tension on the paper must, however, be 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 105 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. 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 115 be regulated and the uniformity of the coating maintained it is desirable that the direction—*i. e.*, the angle or inclination—of the web during its progressive movement should at times be reversed or altered, so that at one point it 120 will travel upward and subsequently downward, or vice versa, thereby arresting or changing the direction of the flow, if any takes place, of the liquid coating upon the traveling web. Thus in the machine illustrated the 125 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.

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 130



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 about thirty feet distant—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 on the surface of the paper, and when this stage has been reached (but not before) it can be suspended in loops upon the drying-frame and remain there until the moisture has evaporated without injury to the coating.

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 cold 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.

We do not claim herein the cooling of the coating, nor that portion of the process embracing the treatment of the paper after the coating has set or stiffened, as said subject-matter is claimed in another division of this application, filed August 18, 1887, and numbered 247,492.

We claim—

1. The herein-described method of producing uniform coatings upon continuous webs or strips of fabric, which consists in applying the coating material in a fluid condition evenly upon the face of the web and in changing the flow of the coating upon the web to regulate and maintain its uniformity, and maintaining the web in motion and its coated surface unobstructed by contact with foreign bodies until the coating has set or hardened sufficiently to prevent running, substantially as described.

2. The herein-described improvement in the art of producing photographic paper, which consists in applying to one face of a web of paper a thin uniform coating or surface of fluid gelatino-argentic emulsion by causing the paper to emerge from the level surface of a body of emulsion, and subsequently maintaining the coated web flat and in motion continuously and uniformly in the same direction, and the surface of the coating undisturbed by contact with foreign substances until the gelatine has set or stiffened sufficiently to prevent running, substantially as and for the purpose set forth.

3. The herein-described process of producing gelatino-argentic fabric for photographic reproductions, consisting in applying to a moving continuous web of fabric a uniform layer of sensitive gelatino-argentic 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 drying said coating.

4. The herein-described method of producing uniform coatings upon continuous webs or strips of fabric, which consists in applying the coating material in a fluid condition evenly upon the face of the web, and subsequently maintaining the web in motion and its coated surface unobstructed by contact with foreign bodies until the coating has set or hardened sufficiently to prevent running, substantially as described.

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