Oct. 14, 1958 T. C. BURNS ET AL 2,855,895

APPARATUS FOR COATING PAPER

Filed Dec. 22, 1954

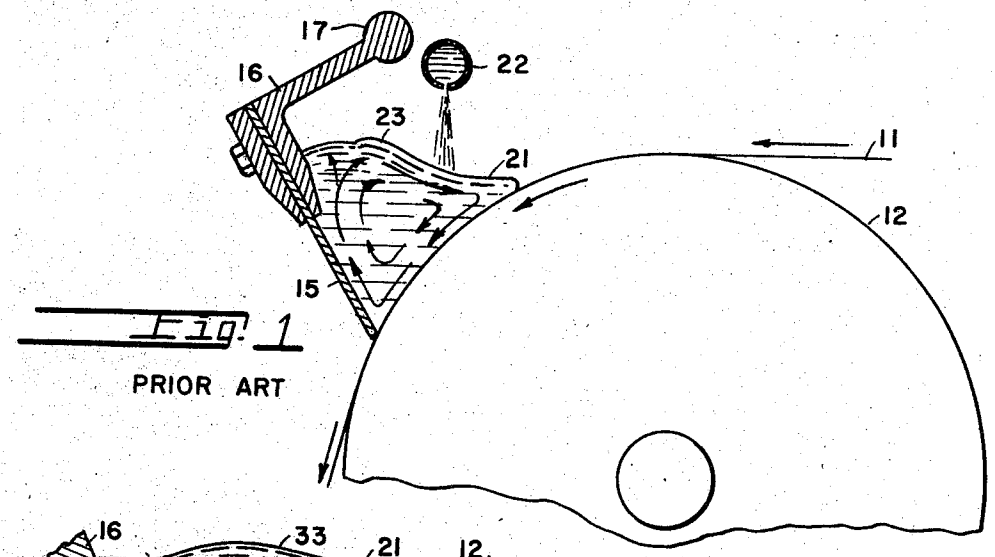


Fig. 1

PRIOR ART

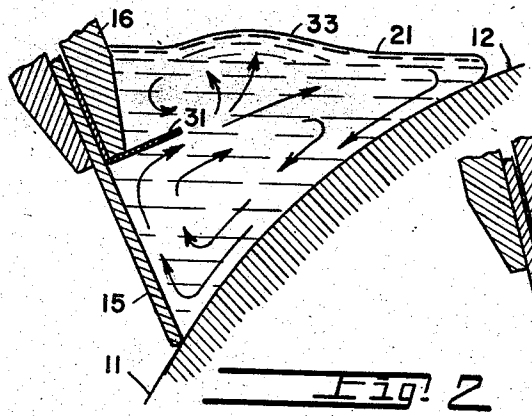


Fig. 2

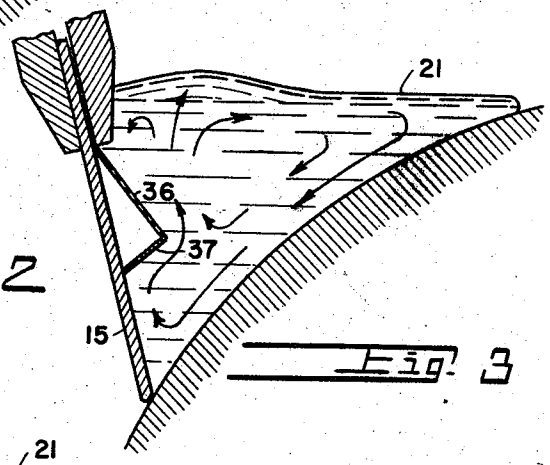


Fig. 3

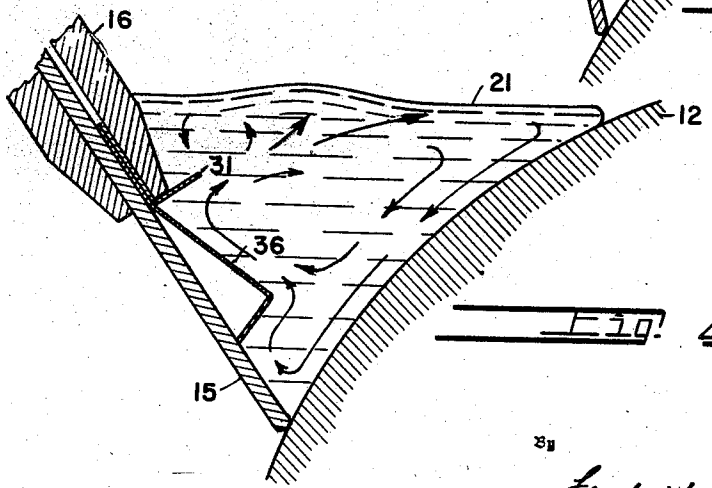


Fig. 4

Inventors

Thomas C. Burns

William H. Marvin

By

Frederick G. L. Boyce

Attorney

United States Patent Office 2,855,895 Patented Oct. 14, 1958

2,855,895

APPARATUS FOR COATING PAPER

Thomas C. Burns and William H. Marvin, Hamilton, Ohio, assignors to The Champion Paper and Fibre Company, Hamilton, Ohio, a corporation of Ohio

Application December 22, 1954, Serial No. 477,015

3 Claims. (Cl. 118—407)

This invention relates to paper coating methods and apparatus. It has particular reference to processes in which fluid coating composition is smoothed into a uniform film on the surface of a paper web by means of a doctor at a location where the paper web is carried on the surface of a rotating roll, and in which a pool of the fluid coating composition is maintained on the surface of the moving web immediately in advance of the doctor. Such coating processes have been successfully used in the coating of large tonnages of paper as a part of its manufacture on the paper making machine. In the commercial use of this process, however, when speeds have been increased above the order of 800 feet per minute, increasing trouble with streaks in the finished coating has been encountered. It is the object of this invention to reduce or eliminate this difficulty and thus make possible higher operating speeds with coaters of this type.

In the said coating process the movement of the paper web in the bottom of the pool of coating tends to carry the coating with it. Since only a minute quantity of the coating is able to pass under the doctor on the surface of the paper, most of the moving coating is held back by the doctor and tends to flow along the surface of the doctor in a direction away from the surface of the roll. It then runs backward over the top of the forwardly moving coating, forming a continuous circulation of the coating in the surface of the pool. This circulation becomes more rapid and the pool of coating becomes visibly more and more violently agitated as the speeds are increased, and this is believed in some way to be responsible for the increasing occurrence of streaks in the finished paper as the speed of operation is increased. We have now found that we can greatly improve the operation and substantially reduce or eliminate the occurrence of streaks in the finished paper, and thereby make higher operating speeds commercially possible, by diverting this outward flow of the coating from its normal path along the surface of the doctor and directing it, at least in part, back towards the center of the pool before it reaches the surface. This, we find, can be conveniently accomplished by providing one or more baffles along the face of the doctor in the path of the stream of coating which tends to flow outwardly along said surface, all as hereinafter more particularly described.

The invention will now be further described with reference to the accompanying drawing in which:

Fig. 1 is a fragmentary diagrammatic view, partially in section, of a coating device of the type described before application of the present invention thereto, indicating roughly how it is believed that the coating in the pool is caused to circulate due to the movement of the paper which constitutes the bottom of the pool.

Fig. 2 is a fragmentary diagrammatic illustration of the pertinent portions of the web-carrier roll and the doctor blade which enclose the pool of coating material,

and showing the modifications which characterize the present invention.

Fig. 3 is a view similar to Fig. 2, but illustrating a modified form of baffle for deflecting the stream of coating flowing outward along the doctor.

Fig. 4 is a similar view illustrating the use of a plurality of baffles for deflecting the outwardly flowing current.

Referring first to Fig. 1, the paper web **11** is carried on the surface of the roll **12** which is rotating in the direction shown by the arrow. The doctor blade **15** is mounted on a suitable framework **16** which may, if desired, be provided with a pivotal mounting, as indicated at **17**, on which it can be swung away from roll **12**, for cleaning, threading, or other purpose. Fluid coating composition is maintained in a pool **21** formed in the angular bight between the surface of the paper web **11** carried on roll **12**, and the doctor **15**. The pool **21** of coating is maintained at the desired depth by continuous or intermittent feeding as through a shower pipe **22**.

The continuous movement of paper web **11**, on roll **12** along the bottom of the pool **21** naturally tends to drag along with it the adjacent portions of the coating, which tendency apparently becomes more and more pronounced as the speed is increased. Since only an extremely thin layer of coating is able to pass under doctor **15** on the surface of the paper web **11**, the major part of the coating which is following the movement of the paper web **11**, is wiped off of the paper by doctor **15** and flows away from the roll **12** along the surface of doctor **15**, as indicated crudely by the arrows in Fig. 1. As the speed is increased, the increase in this current in the pool **21** of coating becomes apparent from an increasingly prominent "boiling up" of the coating as illustrated at **23**. As the speed is stepped up, streaks in the coating on the finished paper become increasingly evident until they reach a point where further increases in speed can not be made without rendering a prohibitively large portion of the production commercially unacceptable.

While the cause of these streaks is unknown, it appears to be related in some way to the turbulence of the coating in the pool **21**. It has been conjectured that at least some of the streaks may be due to air bubbles, assumed to have been entrained in the coating at the turbulent surface of pool **21**, which may be carried onto the paper and drawn under the doctor, resulting in elongated areas of relatively little or no coating on the paper surface. It has also been conjectured that the turbulence may cause local variations in hydrostatic pressure, immediately in front of the working edge of the doctor, which may also be at least in part responsible for some of the streaks observed in the finished paper as speeds are increased. It is also thought that other and less clearly understood causes which may be more or less closely related to turbulence in pool **21**, may be at least partly responsible for the observed defects.

Referring next to Fig. 2, which illustrates one embodiment of the present invention, paper web **11**, carrier roll **12**, doctor **15** and holder **16** are as illustrated in Fig. 1. A new element, baffle **31**, which has been added in Fig. 2, is shown as clamped in holder **16**, along with the doctor blade **15**. The presumed effect of the baffle **31** on the circulation of the fluid coating composition in pool **21**, is indicated by the arrows in Fig. 2 which show how it is believed that the upwardly flowing coating stream is deflected by baffle **31** and directed back towards the relatively quiescent coating material in the center of the pool, before it reaches the upper surface where it appears as a "boiling up" of substantially less intensity than in the absence of baffle **31**. With this arrangement, regardless of theories as to cause, the number of streaks appearing

on the finished paper at any given speed is greatly reduced or entirely eliminated, thus making possible operation at substantially higher speeds than are otherwise possible before the number and severity of defects renders the operation uneconomic.

In Fig. 3 is illustrated a baffle **36** of a different type which has been found useful with coating compositions of lower viscosity than sometimes used with the device illustrated in Fig. 2. Here the portion **37** of the baffle is closer to the paper surface than is the case in Fig. 2. A substantially smaller proportion of the coating which is carried along with the paper web can enter under baffle surface **37**. This, it is believed, is then reversed in direction by the action of doctor blade **15** and baffle face **37** and meets the remaining liquid being carried along with the paper, head-on, thus dissipating the harmful energy well below the surface of the pool, the assumed subsurface currents being again indicated by the arrows.

In other cases, a plurality of baffles can sometimes be effectively combined, as illustrated in Fig. 4, when because of speed, type of coating composition being used, or other cause, it is found difficult to secure a sufficient reduction in turbulence by use of a single baffle.

Because of the wide variety of coating compositions and paper types used in the industry, as well as variations in the size, angular arrangements, and proportions of the coater elements which in themselves form no part of the present invention, it is not possible to give any one set of dimensions and locations for the baffles which are necessary to secure the best results in any one instance. However, the man skilled in the art, by following the instructions herein given, will have no difficulty in securing a substantial reduction, if not complete elimination, of the streaks occurring in the finished paper when operating a coater of this type at any given speed, or in substantially increasing the speed at which the machine can be operated while keeping streaks in the finished paper below practical commercial limits.

When operating the coating device as illustrated in Fig. 1, it will be observed as speed is increased, that the turbulence in pool **21** increases as shown by an increase in size and height of the "boiling up" **23**. As speeds are increased, particularly with coatings of lower viscosity, the whole surface of pool **21** becomes violently agitated and coating material is splashed out of the pool, splattering adjacent parts of the machine and even spotting the paper. At the same time, streaks in the finished paper become increasingly evident until they render the operation commercially impractical.

To correct this condition, a baffle may be inserted as illustrated in Fig. 2 or Fig. 3. If the improvement is insufficient, a broader baffle, i. e. one which projects farther out from the surface of the doctor, may be substituted or an additional baffle may be added as illustrated in Fig. 4. It has also been observed that faulty operation also takes place when the surface of pool **21** becomes too quiescent. If this is found to be the case the second baffle, if present, may be removed. Otherwise a narrower baffle, i. e. one which does not project so far from the surface of the doctor, may be substituted, or the angle of the baffle may be altered so that the outer edge thereof is farther from roll **12**, until the appearance of streaks in the paper is reduced to a minimum or completely eliminated, at the given speed. When this is the case the surface of the pool **21** has, in general, been found to be neither quiescent nor violently turbulent, but only moderately agitated. When a different coating composition, or a rougher or smoother paper stock is substituted for that in use, even though the machine speed remains the same, it is generally true that a change in the form, size, location, or number of baffles may be required to give best results.

To assist in the understanding of the invention, the following example is given: The roll **12** was approximately 20 inches in diameter. The doctor **15** contacted

the roll **12** at a point about 30 degrees above the horizontal and formed an angle of about 45 degrees with the tangent to the roll surface at that point. The pool **21** of coating was then about 5 inches deep at the deepest point. A conventional type of aqueous coating composition was being applied at about 47 percent solids to a conventional coating stock. At speeds up to something over 700 feet per minute, no significant difficulty was encountered due to occurrence of streaks in the finished paper. As speeds were increased to and above 800 feet per minute, however, such streaks became an increasingly serious defect in the resulting product. A baffle similar to that illustrated at **31** in Fig. 2 was then inserted. The baffle projected approximately ⅜ inch from, and formed an angle of about 90 degrees with, the surface of the doctor **15** at a point about 1¼ inches from the surface of the roll **12**. It then became possible to operate at speeds up to 900 feet per minute without any significant formation of streaks.

When using a coating of lower viscosity on a coating device of essentially the same dimensions, best results were secured by use of a baffle such as illustrated in Fig. 3 in which the ⅜ inch width face **37** was in contact with doctor **15** at a distance of about 1 inch from the surface of roll **12**. In cases where the turbulence in the pool **21** was still too great and streaks were still found in the paper, a second baffle was used as, illustrated in Fig. 4, which still further widened the range of coatings which could be satisfactorily used at this speed.

In any case, the man skilled in the art, bearing these instructions in mind, can by watching the agitation of the surface of pool **21**, and correlating this with the degree of perfection or imperfection of the finished product, readily determine whether more or less baffling action is required to give the desired result with the coating composition and paper raw stock and on the specific coating machine at hand and at the speed required, within commercial limits.

It is thus apparent that the present invention, when applied to coating materials and apparatus of the type set forth, serves to better adapt them to use for the coating of paper in the course of its manufacture on modern high speed paper making machines by making possible higher speeds for the coating operation without sacrifice of quality and/or by improving the quality of the product without the necessity for any reduction in speed.

We claim:

1. In a paper coating device which comprises a continuously rotatable paper-web-carrying roll, and a doctor mounted in position for one edge thereof to contact a paper web on the surface of said roll to form an angular bight adapted to maintain a pool of liquid coating composition in contact with a paper web on the surface of said roll immediately in advance of its passage under said doctor; the improvement which comprises the provision of means submerged in said pool for diverting a flow of liquid from along the surface of said doctor towards the surface of said pool and directing it into subsurface portions of said pool.

2. In a paper coating device which comprises a rotatable paper-web-carrying roll; a doctor mounted adjacent the surface of said roll for maintaining a pool of liquid coating composition in contact with paper carried on the surface of said roll and immediately ahead of said doctor, and for allowing only a thin layer of coating composition to remain on the surface of the paper when it is carried by said roll under said doctor, the improvement which comprises the combination with the doctor of at least one baffle extending outwardly from and along the face of the doctor directly into the main body of liquid in said pool, well below the surface thereof, where it is adapted to prevent coating composition in said pool from flowing along the face of said doctor from the paper on said roll surface to the surface of said pool and to direct it into subsurface portions of said pool.

3. A paper coating device which comprises: a continuously movable paper-web-carrying surface, a doctor mounted adjacent thereto with one edge in position to contact a paper web on said surface to form an angular bight adapted to maintain a pool of liquid coating composition in contact with a paper web on said carrying surface, at least one baffle means located well below the surface of the coating composition in said pool, projecting from the face of said doctor, and adapted to prevent liquid from flowing along the surface of said doctor to the surface of said pool and to direct the flowing liquid into the subsurface portion of the main body of liquid in the pool.

References Cited in the file of this patent

UNITED STATES PATENTS

515,941	Savage	Mar. 6, 1894
676,237	Knowlton	June 11, 1901
1,422,545	Doyton	July 11, 1922
1,641,403	Van Derholf	Sept. 6, 1927
2,190,809	Strauch	Feb. 20, 1940
2,328,183	Barrett	Aug. 31, 1943
2,439,802	Francis	Apr. 20, 1948
2,474,691	Roehm	June 28, 1949
2,534,320	Taylor	Dec. 19, 1950
2,681,294	Beguin	June 15, 1954

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,855,895 October 14, 1958

Thomas C. Burns et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 42, after "in the", strike out "surface of the", and insert the same before "pool" in line 43, same column.

Signed and sealed this 22nd day of September 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents