

Dec. 26, 1961

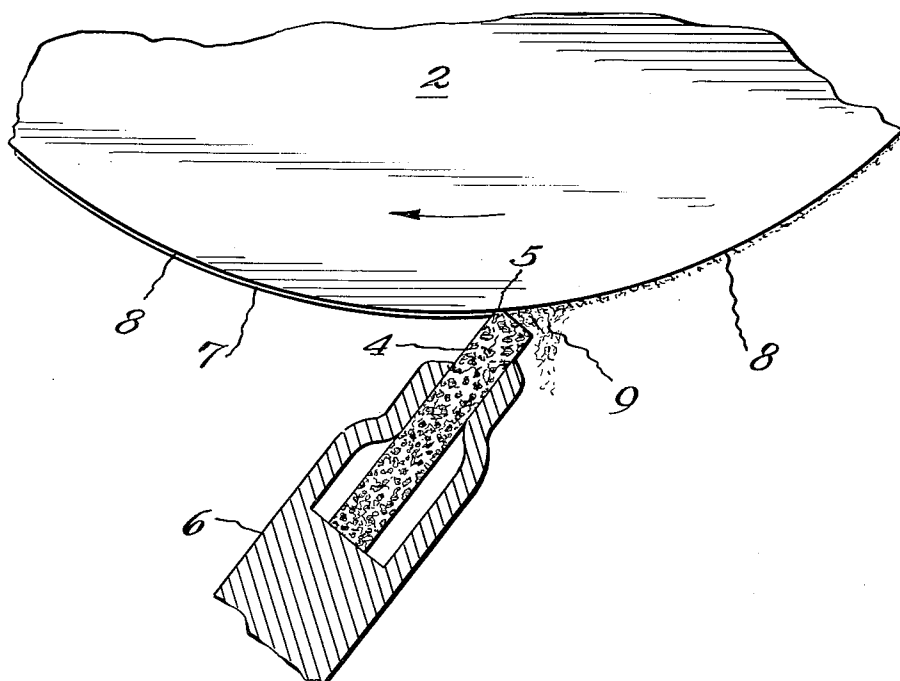
C. A. LEE  
PAPERMAKING MACHINE

3,014,833

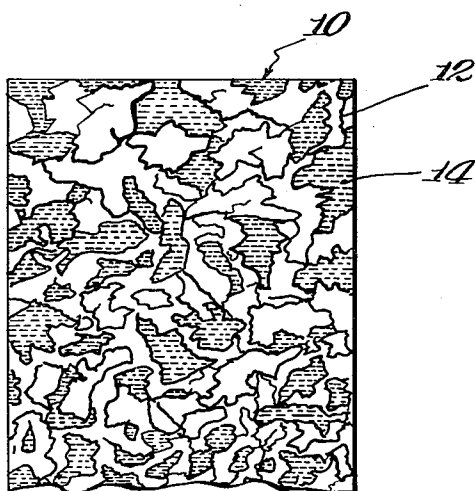
Filed Feb. 24, 1959

2 Sheets-Sheet 1

*Fig. 1.*



*Fig. 2.*



Dec. 26, 1961

C. A. LEE

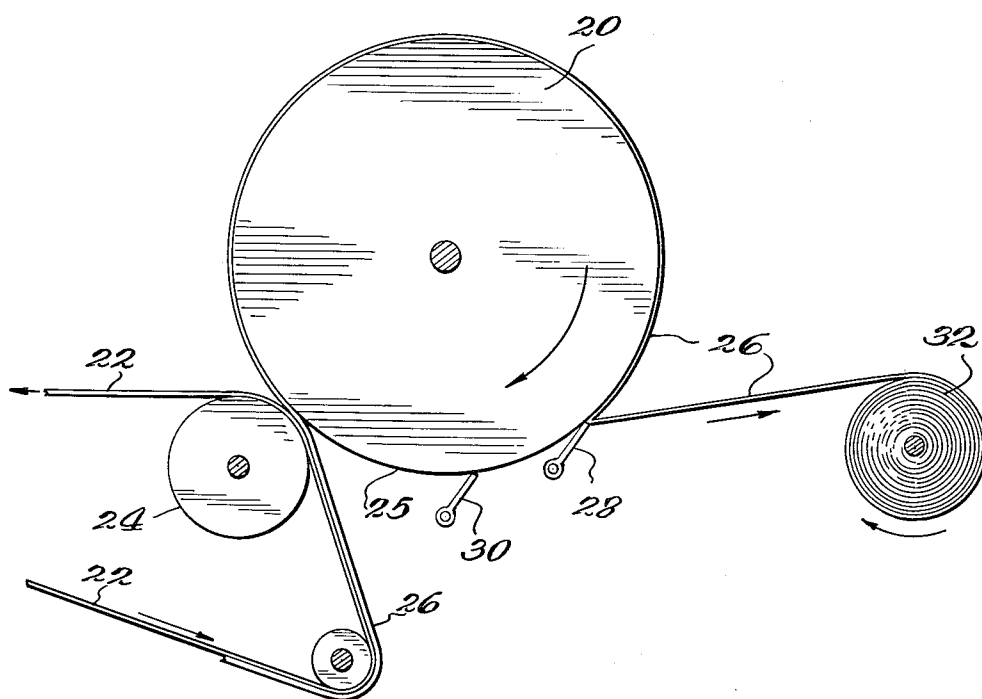
3,014,833

PAPERMAKING MACHINE

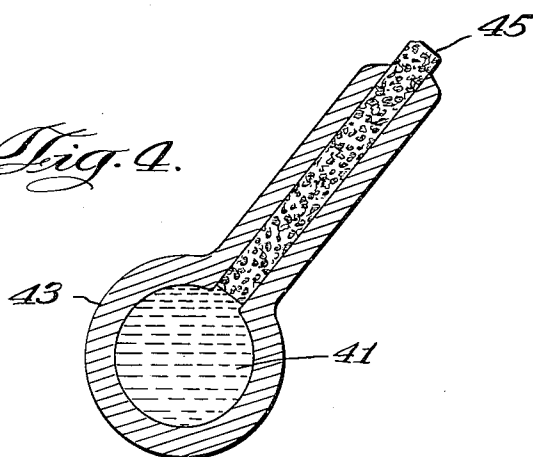
Filed Feb. 24, 1959

2 Sheets-Sheet 2

*Fig. 3.*



*Fig. 4.*



1

3,014,833

## PAPERMAKING MACHINE

Charles A. Lee, Newton, Conn., assignor to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

Filed Feb. 24, 1955, Ser. No. 795,017

8 Claims. (Cl. 162-111)

This invention relates to improvements in doctor blades or scrapers adapted to maintain the surfaces of rotating drying cylinders, calenders, press rolls and the like in proper serviceable condition, and more particularly it relates to doctor blades for use on papermaking machines.

A major object of the invention is to provide an improved doctor blade which effectively conditions its associated roll surface by depositing thereon beneficial materials in minute amounts while simultaneously cleaning the roll surface by removing residual fiber particles and other deleterious materials.

A further object is to provide a cleaning doctor blade for use with the rolls of papermaking machinery which has a particular utility when used in cooperation with Yankee driers in the dry creping process to control the degree of adherence of the paper web to the drier surface.

Another object is to provide an improved method and apparatus having particular utility in fabricating dry creped fibrous webs.

These and other objects of the invention will become apparent from the following description and accompanying drawings.

In the drawings:

FIGURE 1 is a fragmentary view, partially in section, showing a doctor blade embodying the invention, as mounted to be obliquely positioned against the surface of a rotating roll,

FIGURE 2 illustrates in enlarged micrographic representation a section of a doctor blade having the invention incorporated therein and showing a sintered metal impregnated with a lubricating material,

FIGURE 3 is a schematic view of the drying section of a conventional Yankee type paper machine used in the manufacture of dry creped tissue and illustrates a typical positioning of a cleaning doctor blade incorporating the invention in respect to associated structure.

FIGURE 4 is a sectional view showing another modification of the invention.

Cleaning type doctor blades primarily are employed for the continuous removal from their associated rolls of residual fiber particles, dirt, and other deposits considered deleterious to the manufacture of paper. As improvements in modern papermaking machines have permitted progressively increased operating speeds, the loading forces on these cleaning doctor blades as well as creping doctor blades have increased proportionally, with an attendant increase in the danger of damage to the roll surfaces. The roll surfaces of the high speed machines frequently become unserviceable prematurely as the result of excessive wearing, deep scoring, and for other reasons. Excessive wear occurs most frequently at the roll edges where the doctor blades are in dry frictional contact with the drier surface as opposed to those portions of the surface where the transfer of minute amounts of moisture and some non-cellulosic constituents from the web to the drier has a slight lubricating effect between the blade and roll surface. It has been found difficult to apply satisfactorily and uniformly sufficient lubricating means at the roll edges without detriment to the web passing thereover. A need has long existed for an improved cleaning doctor blade which would perform its function in a manner that prevents excessive wear of the roll surface being cleaned without the necessity of attempting to provide independent means for the lubri-

2

cation of the roll edges. The improved doctor blade incorporating the invention described herein not only fills the above needs but contributes other unexpected benefits, such as a controlled releasing action and over-all continuous surface conditioning of the roll surface with which it is associated.

In the drawings, FIGURE 1 illustrates a doctor blade 4 mounted in a suitable holder 6 for positioning the blade obliquely of the surface of a rotating roll 2 in respect to which it is adapted to serve as a cleaning doctor. The blade holder 6, may be of any known type, the detailed construction of which forms no part of the present invention. In operation, the doctor blade 4 removes deleterious materials shown at 9 from the roll surface 8 while simultaneously applying to surface 8 a thin coating 7 of functional materials.

In a preferred embodiment of the invention, edge 5 of the doctor blade 4, which is in direct contact with the drier 2 is prepared for service by grinding a concave bevel therein which fits closely the arc of the drier surface. Alternatively, a doctor blade having an initially sharp edge may be "worn-in" by operating the machine in a dry run with the doctor blade in contact with the drier surface, until the desired configuration is obtained.

Although it is known that a transfer of beneficial materials takes place from doctor blade to drier surface, the exact mechanism of the interaction between the two is not completely understood. The novel structure of the doctor blade is mostly likely responsible for its effectiveness. FIGURE 2 illustrates such a structure in a micrographic representation. The doctor blade 10 consists of a porous structure of sintered powdered metal 12 the pores of which are filled with a lubricating material 14. The sintered blade may be used with or without the lubricating material present depending upon the particular operating conditions involved. In another modification, the porous sintered metal 12 may be of a hard metal infiltrated with a softer metal in place of the lubricating material 14.

The sintered metal may be of any suitable material such as bronze, brass, copper, stainless steel, iron, aluminum, zinc, etc., or their alloys. Before being compacted, prior to the conventional sintering process, the metal is usually in a powdered or fibrous state. An especially suitable material has been found to be an alloy which is known as a true graphite bronze, a common example of which analyzes: 89% Cu, 10% Sn, and 17% C. (graphite). The commercial alloys known as Oilite, Compo, Johnson Bronze Graphited Bearings, Durex, and Gramix are of this general type although additives other than graphite are sometimes used in their compounding. ASTM Tentative Standard Specification B202-55T describes a similar alloy which is suitable.

The lubricant with which the porous metal blade is impregnated is of the type capable of producing a thin film on the rotating surface against which the doctor blade is pressed. Useful for this purpose are mineral oils, fatty acids, waxes, silicones, fatty acid soaps and vegetable oils. Mineral oils have been found to be especially suitable. The impregnation usually lasts for the life of the doctor blade but the latter may be reimpregnated if the lubricant is exhausted prematurely because of severe operating conditions or other causes. Alternatively a continuous supply of lubricant may be forced through the porous doctor blade by hydraulic or pneumatic pressure.

As indicated previously, the doctor blade of this invention is useful wherever a cleaning doctor is utilized on rotating rolls of paper machines. It has particular utility for paper machines used in the manufacture of dry-creped tissue webs. Its particular utility in the latter operation lies in its ability to control the adherence of the paper web to the drier surface, permitting the use by the manu-

facturer of a wider range of pulps than normal without sacrificing quality or performance.

In the manufacture of dry-creped tissue, it is important to obtain the proper amount of adhesion between the web and the drier surface in order to produce satisfactory creping results. When there is too little adhesion, the web tends to flare from the drier without being creped, or when creped, produces too coarse a crepe. Conversely, when the web adheres too tenaciously to the drier surface, the web is often creped more finely than desired in the finished product. The problem of too little adhesion usually is solved by adding various glues or adhesives to the furnish prior to forming the sheet. Too much adhesion or excessive sticking, on the other hand, is not solved satisfactorily by simple beater addition of release agents. The latter must be added in such quantity to achieve release that an undesirable loss in sheet strength results. Further, when sticking is excessive, breaks in the web occur more frequently than normal necessitating stops and slowdowns in production.

It has been found desirable not only to provide the proper amount of adhesion between the web and the drier surface but also to have a uniform degree of adhesion across the entire width of the web to provide an overall, even creping pattern in the finished product. This is accomplished when a uniformly smooth drier surface is presented to the web. The doctor blade of the novel structure described herein conditions the roll surface in a manner which provides the desired uniformity in surface smoothness as well as the desired degree of adhesion.

The exact causes of excessive drier sticking have not been isolated completely. However, experience indicates that drier sticking is attributable to the following causes individually or in combination. (1) The presence in the pulp of non-cellulosic constituents such as wet strength resins, insoluble mineral salts, and certain carbohydrate compounds. (2) The absence in some pulps of natural pitchy materials, which ordinarily exhibit lubricating qualities. (3) The use of highly refined pulp in the papermaking furnish. (4) The use of hard water in the manufacturing process.

Attempts have been made to control excessive adhesion by adding certain lubricating materials such as soaps to the papermaking furnish, but these have met with only limited success. As indicated previously, this tends to weaken the sheet. Also where the sticking problem is extreme, as when sulphate pulps and certain West Coast and Southern sulphite pulps are used, which lack some of the natural lubricants such as pitch, this expedient is not satisfactory. The basic solution to the problem requires a properly conditioned drier surface. The doctor blade of this invention serves to condition the drier surface properly.

FIGURE 3 schematically illustrates the application of this invention to the dry-creping process. The tissue web 26 carried on felt 22 is applied to the surface of a Yankee drier 20 by pressure roll 24 after the drier surface 25 has been conditioned by the cleaning doctor 30 of this invention which is obliquely positioned relative to the drier surface and in opposition to its direction of rotation. The web is creped from the Yankee drier by a creping doctor 28 and wound up in the finished roll 32. Although only one creping doctor 28 is shown in the drawing, a second doctor position is usually provided to allow quick changes in the creping blade without interrupting machine operation.

The beneficial surface conditioning which results from the use of the doctor blade of this invention is believed to derive from the particular structure of the doctor blade and includes two independent conditioning actions. One action is the release of minute particles of the sintered metal itself to fill in tiny irregularities of the cooperating roll surface. This improves the surface characteristics beyond those provided by ordinary surface smoothing techniques. Because of the doctor blade's novel sintered

structure the transfer of metal particles from the blade to the roll surface is believed to be physically easier than when ordinary solid metals are used as cleaning doctors. The second action is the application of a thin film of lubricating material by the doctor blade to the cooperating roll surface. The lubricant is transferred to the roll surface from the porous blade by a wicking action and provides a roll surface having excellent release properties. Each of these actions are in addition to the scraping and cleaning function normally provided by cleaning doctors.

The wicking action of the porous blade may be physically assisted by enclosing the entire blade, except its working edge, in a sealed chamber including a supply well, and applying hydraulic or pneumatic pressure to the chamber to force more lubricant through the pores of the blade to the blade-cylinder interface.

The blade holder, shown in section in FIGURE 4 includes a doctor blade 45 of sintered or other porous material which is maintained clamped in a supporting housing 43. The supporting housing includes a well-like cavity 41 in which lubricant is maintained under hydraulic or pneumatic pressure from a pressure source not shown. Pressurized lubricant is in continuous contact with the lower end wall of blade 45 to insure forced wicking action of the lubricant through the blade material for continuous application thereof to the surface of a cylinder against which the upper edge of the blade is positively engaged.

Where release properties are not usually required, as with calender rolls, press rolls, ordinary drying cylinders and the like, an unimpregnated sintered metal blade may be used to provide only the first mentioned surface conditioning action.

In addition to the above-mentioned improvements in surface conditioning and lubricating, other benefits have been derived from the use of the invention in dry creping. Among these are longer life for creping doctor blades, less pressure loading on the creping doctor blade to obtain satisfactory creping, less wear on the web-free edges of the drier, fewer incidents of scoring damage by the creping doctors, and longer periods of continuous running without requiring the usual surface reconditioning roll grinds.

Although it has been pointed out specifically that the doctor blade of this invention is especially useful in the dry-creping process, it is readily discernible to those skilled in the art that the invention has unusual utility in other applications in paper manufacturing and related processes. For example, the invention can be used to advantage on regular drying cylinders in the paper and textile industry, on Yankee driers in the manufacture of machine glazed sheets, on press rolls, on calender rolls, on casting cylinders in the cast coating process, and on casting cylinders in plastic film manufacture.

It is also considered within the scope of this invention to provide a sintered metal doctor blade in which the basic sintered structure is of a hard metal such as steel or iron infiltrated with a softer metal such as copper, brass, or lead.

Other methods and means of applying the principles of this invention may be used without departing from its spirit or scope as specifically pointed out and described in the above specification and the appended claims.

What is claimed is:

1. The method of drying creping cellulose webs from a heated drum drier consisting of the steps of continuously rotating the drum, uniformly lubricating the surface of said drum by maintaining in pressure engagement therewith a flexible lubricant-impregnated porous sintered metal doctor blade, applying under pressure a wet fibrous web to the thus lubricated drier surface, drying said web during rotation of the heated drum, and thereafter creping the substantially dry web from the drum surface.

2. The method of continuously supplying lubricant uniformly to the surface of a rotating cylinder consisting

5

of the steps of maintaining in pressure engagement with the surface of said cylinder a doctor blade of porous sintered metal and maintaining a supply of lubricant under positive pressure against a portion of the blade remote from the cylinder engaging surface thereof, whereby a continuous supply of lubricant is forced through the pores of said blade to the surface of said cylinder.

3. A method for controlling the degree of adherence of a fibrous web to a moving drier surface consisting of the steps of rotating a heated drying cylinder, continuously applying to the surface said cylinder a lubricous film by maintaining in pressure engagement therewith a metal doctor blade consisting of lubricant impregnated porous sintered metal, pressure applying a fibrous web to the cylindrical surface thus lubricated, effecting substantial drying of said web during rotation of the cylinder, and continuously removing the dried web from the cylinder in advance of said doctor blade.

4. An apparatus for controlling the degree of adherence of a fibrous web to a heated rotating drier surface which comprises in combination, a heated drum drier, means for rotating said drier, a lubricant-impregnated porous sintered metal doctor blade, and means for holding said doctor blade obliquely to, and in engagement with the surface of the rotating drier.

5. An apparatus for dry creping a fibrous web which comprises in combination, a heated drum drier, means for rotating said drier, a porous sintered metal cleaning doctor blade, means for holding said blade obliquely to and engaged with the surface of said drum, pressure means for continuously applying a fibrous web to said surface at a point trailing the cleaning doctor blade, and

6

means for creping said fibrous web from said drum surface at a point in advance of the blade.

6. The apparatus of claim 5 in which said porous sintered metal cleaning doctor blade is impregnated with a lubricant.

7. In an apparatus for controlling the degree of adherence of a fibrous web to a heated moving drier surface, the improvement which consists of the combination of a porous sintered metal doctor blade and means for continuously supplying lubricating fluid through the pores of said blade, and means for maintaining said blade in pressure engagement with the surface of a rotating cylinder.

8. In a device of the character described, a doctor blade consisting of a sintered metal of sufficient porosity to permit pressurized fluid flow therethrough, a rotatably mounted heated drier drum, means for the rotation of said drum, means for mounting said blade obliquely of a tangent to said drum with an edge thereof in pressure contact with the drum surface, and means for maintaining fluid lubricant in pressure contact with said blade at a position remote from the drum contacting edge thereof.

#### References Cited in the file of this patent

#### UNITED STATES PATENTS

|           |                |               |
|-----------|----------------|---------------|
| 1,772,185 | Liebeck        | Aug. 5, 1930  |
| 1,933,837 | Arnold         | Nov. 7, 1933  |
| 2,313,830 | Lundbye        | Mar. 16, 1943 |
| 2,377,632 | Keller         | June 5, 1945  |
| 2,731,360 | Love           | Jan. 17, 1956 |
| 2,851,354 | Scanlan et al. | Sept. 9, 1958 |
| 2,882,589 | Stafford       | Apr. 21, 1959 |