June 17, 1969 G. V. WILLIAMS, JR 3,450,098

DOCTOR FOR PAPER-MAKING MACHINE

Filed April 2, 1968

FIG. 1

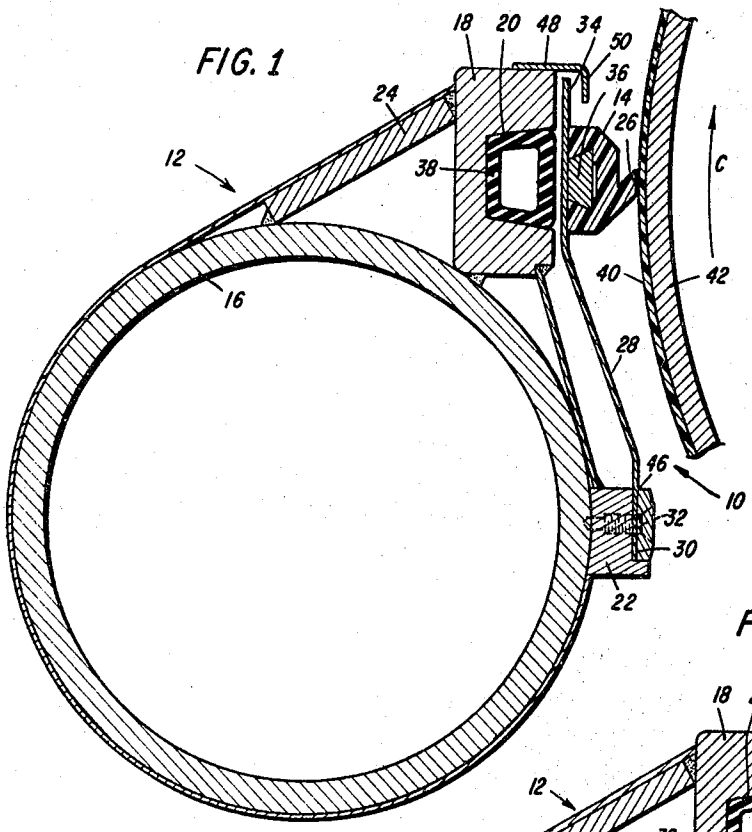


FIG. 2

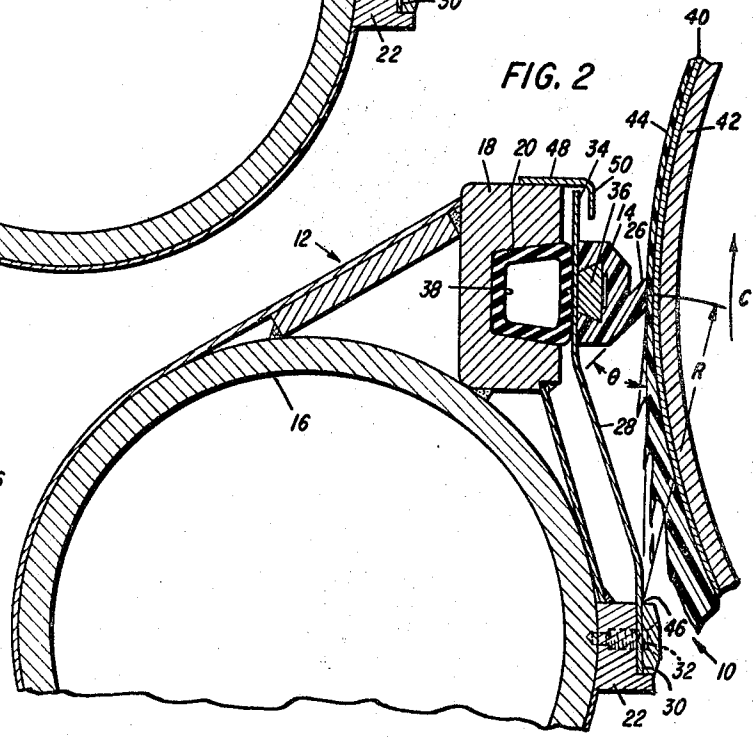
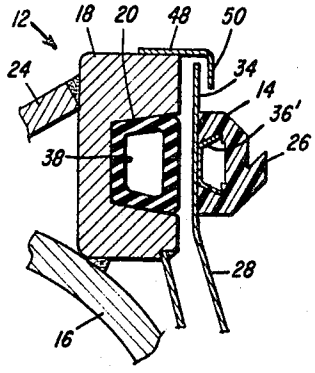


FIG. 3



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DOCTOR FOR PAPER-MAKING MACHINE

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ABSTRACT OF THE DISCLOSURE

A doctoring device is provided which utilizes a flexible polymer doctor blade element for smoothing and metering a film forming deposit on paper as the paper moves thereby on a suitable backing roller. The doctor blade is backed by an inflatable tube which, through its expansion, uniformly moves the blade into contact with the moving paper web. The doctor blade is mounted on a free edge of a spring strip and the strip is anchored at its opposite edge.

The present invention relates to a doctoring device, and more particularly, to a device for smoothing and metering film-forming deposits on a suitable substrate moving thereby.

In the paper manufacturing field, it is conventional after forming a paper web to apply a coating to the surface of such web. When applying this coating, it is customary to first apply an excess amount of the coating and to then wipe the excess off while the remainder is trowled or smoothed onto the paper web surface. The wiping process thus partially acts as a method of metering the coating to provide a given amount of coating at a given thickness. In such a process it is conventional to support the traveling paper web by a rotating backing roll, although other types of devices are also used. A similar operation is carried out in the coating of other webs, such as plastic webs, and in the casting of self-suporting polymeric films. In the latter case the film forming material is fed from a suitable hopper to a smooth rotating roller and a suitable doctor blade, either adjacent to or forming part of the feeding hopper, smooths and meters the cast material onto the rotating roll.

In the past such smoothing and metering doctors have consisted of a simple doctor blade in the form of a relatively thin and flexible metallic plate. Such a doctor blade is generally mounted on a doctor back or support which extends along the length of the doctor blade and holds the doctor blade at an acute angle to the tangent at the line of contact of the rotating backing roll. The doctor back is, in turn, pivotally supported at each end on its journals. The pressure of the blade against the backing roll is developed by either the overhanging weight of the doctor back and blade in relation to the journals or by torque applied to the journals. Flexible blades of the prior art will not deflect until they make contact with the backing roll. After making contact, such blades will have increasing deflections with increasing blade pressures.

It is elementary that the pressure of the blade against the backing roll must be uniform across the entire face of the roll if the metering of the coating onto the traveling web is expected to be uniform across its width. To assure this uniform blade pressure, the blade and doctor back must both be machined to a high degree of accuracy. This accuracy must then be maintained during the coating operation for various blade pressures. Until the present time, and in spite of many recent advances in doctor design, it has been impossible to completely fulfill these requirements. To assist in overcoming inaccuracies at various blade pressures, it has been conventional in the prior art to incorporate adjustment features across the doctor back so that compensation for these inaccuracies could be made. In present practice such compensations must be made frequently, particularly after a change in blade pressure has been made or a new blade has been inserted in the doctor back.

Since all blades wear, they must be replaced periodically. Rather than discard the used blades, they are conventionally refinished and kept on hand for future use. As the blades continue to wear and are repeatedly refinished, they become shorter. However, there are coating situations where the point and angle of contact of the blade against the backing roll must remain constant. For these cases either the blades are installed with a variable amount of shims to assure duplicate projections of the blade from the doctor back, or the doctor back is repositioned to compensate for the change in blade position. The problem is further compounded because the chamber within the doctor back that receives the blade and shims usually builds up with a coating and requires frequent attention. When the point and angle of contact must remain constant throughout a range of contact pressures, the doctor back must also be repositioned to compensate for the varying amountof blade deflection.

It is, accordingly, an object of the present invention to overcome and reduce the deficiencies of the prior art, such as indicated above.

It is another object of the present invention to provide for automatic compensation for machining inaccuracies of doctor blade and doctor back.

It is another object of the present invention to provide for automatic compensation for warpage or doctor blade and supporting structure after the machining thereof.

It is another object of the present invention to provide for automatic compensation for inaccurate alignment of doctor supporting structure and retention of alignment under varying doctor blade pressures.

It is another object of the present invention to provide for automatic compensation for variable blade projections.

It is another object of the present invention to maintain a line and angle of contact between doctor blade and substrate throughout a range of contact pressures without repositioning the doctor blade supporting structure.

It is another object of the present invention to provide a new and improved doctoring device for smoothing and metering film forming deposits on a suitable substrate, which device is capable of being simply adjusted over a variety of pressures and which device is highly reliable.

These, and other objects and the nature and advantages of the instant invention will be more apparent from the following detailed description of an embodiment, taken in conjunction with the drawings wherein:

FIG. 1 is a vertical sectional view of a doctoring device in accordance with the present invention in facing, non-operative, position with respect to a substrate for coating;

FIG. 2 is a vertical sectional view of the device of FIG. 1 showing the smoothing of a deposit on a suitable substrate; and

FIG. 3 is a partial vertical sectional view of an embodiment slightly altered from the embodiment of FIG. 1.

A doctoring device **10** is shown generally in FIG. 1 and comprises a doctor back **12** and doctor blade **14**. The doctor back **12**, in the illustrated embodiment, includes a longitudinally extending tubular portion **16**, a U-shaped portion **18** carrying a recessed groove **20**, an anchoring or clamping portion **22**, and a reenforcing element **24**, all of which extend longitudinally in a direction

transverse to the direction of coating application, as illustration, as illustrated by the arrow C.

The blade **14** preferably has a generally Y-shape, as illustrated, with a relatively thick cross-section and preferably terminates in a flat end portion **26**. It is an important feature of the present invention that the blade **14** be formed of a flexible material, preferably a synthetic polymeric material such as polyurethane, polyethylene, nylon or rubber.

The blade **14** is connected to the doctor back **12** by a transversely extending resilient supporting means preferably consisting of a spring strip **28**. The spring strip **28**, preferably formed of spring steel, is anchored along one edge **30**, by means such as through bolts **32**, to the clamping portion **22** of the doctor back **12**. Adjacent the opposite free edge **34** of the spring steel clip **28** is provided a connection for the doctor blade **14**. In the illustrated embodiments a dovetail bar **36** (FIGS. 1 and 2) is provided for such releasable connection of the spring strip **28** to the doctor blade **14**, or alternately a dovetail spring clip **36'** (FIG. 3) may be used. As can be seen, the blade **14** slides over the dovetail bar **36** or the dovetail spring clip **36'** into a cantilevered position on the strip **28**.

Lying directly behind the doctor blade **14** and the spring steel clip **28** and recessed within the groove **20** of the U-shaped portion **18** is an inflatable tube **38** which runs the full length of the doctor device **10**. The tube **38** is elastic and inflatable and is preferably formed of natural or synthetic rubber. Such tube is provided with suitable means (not shown) for the inflating thereof either pneumatically, which is preferable, or hydraulically, FIG. 2 showing the tube **38** in its inflated position.

Opposite the end **26** of the blade **14** is situated a substrate **40** to be coated. In FIG. 1 it is seen that the substrate such as a web of paper or plastic is supported by a rotating roller **42**. In FIG. 2 a coating **44** is shown being applied to the paper substrate **40** supported by the roller **42**. A polished metallic roller substrate may be used for application of a film forming composition thereto which sets to a self-supporting film which is subsequently peeled from the roller. The movement of the substrate **40** past the doctor blade **14** is designated by the arrow C.

When the inflatable tube **38** is deflated as shown in FIG. 1, the spring strip **28** is in its undeflected position holding the blade **14** a short distance from the face of the substrate **40**. When the tube **38** is inflated, as shown in FIG. 2, it will make contact with the back of the spring strip **28**, deflecting it until the blade **14** makes contact with the substrate or the coating applied to the substrate. The inflatable tube **38**, containing a uniform pressure along the length of its entire face, will uniformly transfer pressure to the flexible and resilient wiper blade **14**, thereby producing a uniform contact pressure across the entire face of the doctor blade end **26**. As the end **26** of the blade **14** wears, the tube **38** will continue to expand, thus maintaining the contact pressure between the blade and coating.

Accordingly, and in contrast to the prior art, the loading action of the inflatable tube **38** is applied directly behind the blade **14** along the radius extending from the center of the backing roll through the blade end **26**, the result of which is the termination of deflection of the spring strip **28** after the blade **26** makes contact with the substrate. For this reason the angle of contact machined into the blade end **26** will not be affected by the air pressure in the inflatable tube **38** developing the various blade pressures.

As the blade **14** moves to make contact with the substrate and as it wears it will move in an arc having a radius equal to R about an axis defined by the line **46** about which the spring strip **28** deflects. When the axis **46** is located along the tangent to the line of contact as illustrated, there will be but negligible change in the point and angle of contact as the blade end **26** wears or as blades in a range of thickness are interchanged. In order to accomplish providing the line **46** along such a tangent plane, it is preferable to provide the spring strip **28** with a non-linear configuration as shown. It is also preferable to provide the flat end portion **26** of the blade **14** along the tangent plane (coplanar therewith) at the line of contact and defining an angle θ with a body portion of the blade as illustrated in FIG. 2.

For positions of the doctor blade as shown in the illustrated embodiments, it is preferable to provide a shield **48** to protect the inner portions of the device **10** between the spring strip **28** and the doctor back **12**. The downwardly projecting end portion **50** of the shield **48** also serves as a stop or limits the movement of the free end **34** of the strip **28**, in turn limiting the movement of the doctor blade **14** as pressure increases or as the blade end **26** wears down.

It should be understood that while the positioning of the doctor device as illustrated is preferred, it is not necessary that the axis **46** be located on the tangent to the contact point. Furthermore, the doctor device **10** of the present invention may take various forms and is not limited to any particular type of substrate **44**, or to any particular backup device **42** for support of a moving web **44** treated by application of surface coatings thereto by means of the doctoring/smoothing device. Thus, such backup devices may be either a rotating roll, as illustrated, or a fixed mandrel with varying degrees of surface treatment or surface materials contacting the moving web on the surface opposite to the one being coated.

Doctor blades in accordance with the present invention may be used in conjunction with a coating applicator device in which case the blade serves merely to meter and smooth the coating, or such a doctor may serve as part of the coating applicator, such as by serving as a boundary for a coating pool.

It will be obvious to those skilled in the art that various changes may be made without departing from the scope of the invention and that the invention is not to be considered limited to what is shown in the drawings and described in the specification.

What is claimed is:

1. A doctoring device for smoothing and metering film forming deposits on a suitable substrate comprising:

a flexible doctor blade element adapted to trowel a film-forming deposit on a substrate moving thereby, said blade element extending lengthwise in a direction transverse to the direction of movement of the substrate thereby;

transversely extending means to resiliently support said blade element in proximity to the location of the moving substrate and to resiliently bias said blade element away from the location of the moving substrate;

said supporting means comprising a flexible element anchored at one portion and carrying said doctor blade adjacent a free and end thereof;

inflatable tube means lying behind said doctor blade and extending the length of said blade, said inflatable tube being out of operative contact with said blade when not inflated;

means to inflate said tube means whereby said tube is placed in operative contact with the back of said blade to thereby force said blade forwardly to overcome the resilient backward bias of said support means and move said blade uniformly toward the location of the moving substrate; and

a stop means for limiting the extent of movement of the free end of the supporting means toward the moving substrate.

2. A doctoring device in accordance with claim **1** wherein said flexible element comprises a spring strip and said one portion is along one edge of said strip and said strip carries the doctor blade cantilevered adjacent the free edge opposite said one edge.

3. A device in accordance with claim 2, wherein the substrate comprises a web to be coated, said device including a web supporting backing roll in proximity to said blade element and wherein said blade end is broad and flat and is tangent to said backing roll.

4. A device in accordance with claim 2 wherein said doctor blade is atached to said spring strip by a dove-tail connection.

5. A device in accordance with claim 2 wherein said stop means for limiting the extent of movement of the free edge of said spring steel strip toward the moving substrate.

6. A device in accordance with claim 3 wherein said anchored edge of said spring strip is located along the tangent to said backing roll at the line of contact between said blade and backing roll.

7. A device in accordance with claim 1 wherein said blade is generally Y-shaped in section, with the two arms of the Y held by the supporting means and with the leg of the Y having one edge which forms the operating

edge of the doctor blade in relation to the moving substrate.

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