

- [54] **COATING ROLLER**
- [75] Inventor: **Robert J. O'Connor**, Rochester, N.Y.
- [73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.
- [22] Filed: **Nov. 22, 1971**
- [21] Appl. No.: **200,910**
- [52] U.S. Cl..... **29/130, 118/50, 101/348**
- [51] Int. Cl..... **B21b 31/08**
- [58] Field of Search..... **118/50, 410-412; 29/110, 129, 129.5, 130, 132; 117/34; 101/348, 375, 350**

2,761,419	9/1956	Mercier et al.	118/412
2,761,791	9/1956	Russell.....	117/34
3,365,774	1/1968	Kusters	29/129.5 X
2,925,088	2/1960	Roscoe	29/130 X

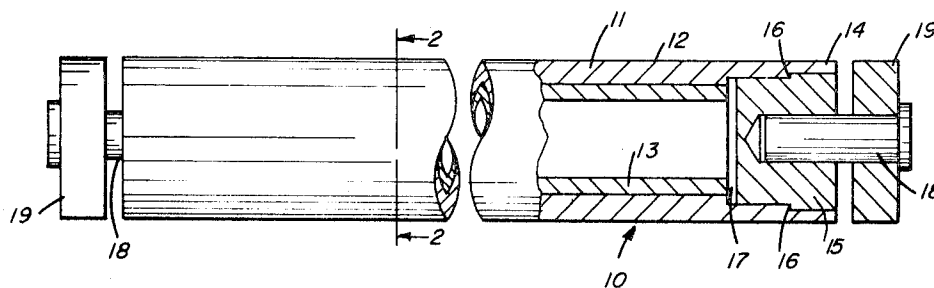
Primary Examiner—James Kee Chi

[57] **ABSTRACT**

An improved coating roller, particularly for use in coating photographic compositions onto webs, including a tubular generally-cylindrical roller member and a tubular generally-cylindrical insert shrink-fitted into the roller member, such that the interference interface between the members dampens vibrations imparted to the roller. Prior to insertion the OD of the insert is approximately equal to the ID of the roller member within a tolerance of ± 0.001 inches. The insert extends axially within the outer member so that at least fifty percent of the inner surface of the roller member is frictionally engaged by the outer surface of the insert.

3 Claims, 3 Drawing Figures

- [56] **References Cited**
- UNITED STATES PATENTS**
- | | | | |
|-----------|---------|---------------------|-----------|
| 2,926,628 | 3/1960 | Black et al. | 29/130 X |
| 3,447,221 | 6/1969 | Odiorne | 29/130 X |
| 3,014,266 | 12/1961 | Samuels et al. | 29/130 X |
| 2,761,417 | 9/1956 | Russell et al. | 118/412 X |
| 2,761,418 | 9/1956 | Russell..... | 118/412 X |



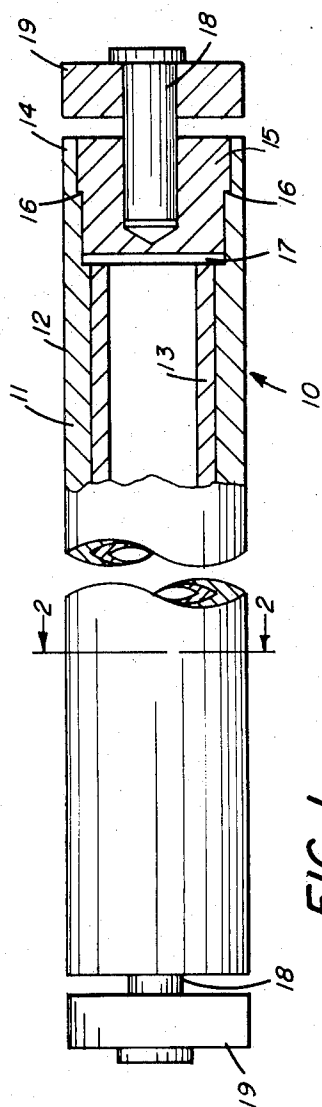


FIG. 1

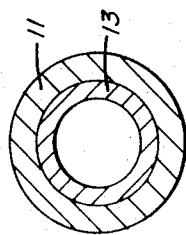


FIG. 2

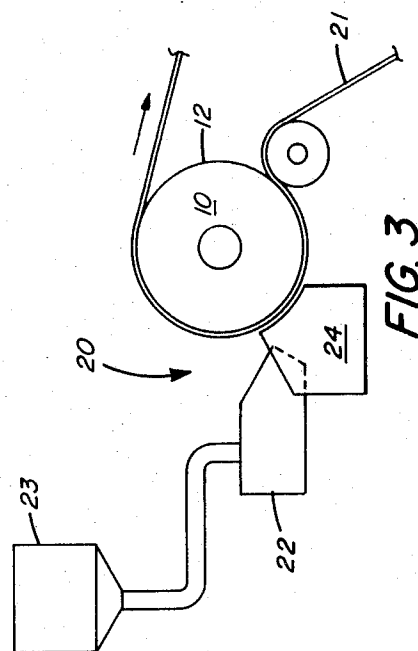


FIG. 3

1

COATING ROLLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an improved coating roller for use in the coating of webs, for example, with photographic compositions.

2. Description Relative to the Prior Art

In coating webs with one or more layers of photographic compositions the thickness of the coatings must be extremely uniform. One problem that arises in such coating is non uniformity in a pattern of alternating transverse thick and thin areas. Such a pattern is known in the coating art as "cross-lines" or "cross-cuts," and products containing this pattern are unsuitable for most purposes.

In certain instances, cross-lines are produced by vibration(s) in the coating apparatus. Such vibration(s) may arise from many sources, e.g., air circulating systems, web drives, noise in the coating room, etc. One technique for eliminating cross-lines formed in a coating is to eliminate the source of the vibration(s), but this may be impractical. Another technique is disclosed in British Patent No. 1,216,066, according to which a cavity of air in contact with the liquid being coated acts as a buffer cushion to reduce the amplitude of vibrations in the liquid. Such a technique may be undesirable, particularly in the coating of photographic compositions, as air in the cavity may become trapped in the liquid to be coated and thereby cause air bubbles to be formed in the coating. Furthermore, the modification of existing coating hoppers so as to provide such air cavities involves considerable expense, and vibrations in the coating roller may still cause cross-lines to appear in the coating.

In a textbook by J. P. DenHartog entitled *Mechanical Vibrations* (Third Edition, 1947) at page 133, there is disclosed a technique for eliminating noise caused, for example, by the gears of an electric streetcar. According to that technique, a steel or cast iron ring is shrunk fit inside of the rim of each gear. With the proper fit, noise may be substantially eliminated. However, noise from the gears as described in that textbook is generally caused by radial vibration. In coating processes employing rotating coating rollers, on the other hand, the vibration primarily responsible for the formation of cross-lines tends to flex the roller with the roller ends being vibration.

SUMMARY OF THE INVENTION

It is an object of this invention to substantially reduce transverse vibration in coating rollers and thereby eliminate cross-line patterns in products coated on such rollers. Such transverse a coating roller when the vibration source(s) has a frequency at or about the natural frequency of the roller. Such transverse vibration of a coating roller may be recognized by the pitch of the cross-lines which corresponds to a disturbance at a frequency close to the natural frequency of the coating roller or harmonics thereof.

This and other objects are accomplished by coating roller apparatus according to the invention comprising a tubular generally-cylindrical insert member shrunk fit within a tubular generally-cylindrical roller member, so that the amplitude of vibrations tending to bend the

2

coating roller transversely is reduced by the frictional interface between those members.

As used herein, a coating roller is a roller that is used to support a web in proximate relationship to a coating device, such as a hopper for deposit of a coating on the web, or is a roller adapted for casting material directly deposited onto the roller. With the use of the improved coating roller as described herein, cross-lines produced in coated products that are attributable to vibration(s) of the coating roller can be substantially eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a representation of a longitudinal cross-sectional view of an improved coating roller embodying features of the invention,

FIG. 2 is a transverse cross-sectional view taken on line 2—2 of the coating roller shown in FIG. 1, and

FIG. 3 is an elevational representation of a coating apparatus showing an environment in which a coating roller according to the invention may be used.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

With particular reference to FIGS. 1 and 2, an improved coating roller 10 has an outer generally-cylindrical tubular roller member 11 of, for example, steel having a peripheral surface 12. A web may be supported upon the surface 12 in proximate relationship to a coating hopper. Within the member 11 is a generally-cylindrical tubular insert 13. The insert 13 extends coaxially with the member 11 for at least a major portion of the length of the member 11, i.e., at least 50 percent of the axial length of member 11, and preferably for the entire length of the member 11, exclusive of the end portions 14 of the member 11. Thus, at least 50 percent of the inner surface area of the tubular outer member 11 is adapted to be frictionally rubbed by the outer surface of the insert 13 during vibration of the coating roller.

Prior to insertion the insert 13 has at room temperature an outer diameter that is machined to a tolerance of ± 0.001 inches (± 0.0025 cm) of the inner diameter of the member 11. Insert 13 may be positioned into member 11 by conventional shrink-fitting techniques, i.e., by heating the member 11 and/or cooling the insert 13. As used herein, the term "shrink-fit" contemplates either of the fabrication techniques described in the previous sentence. The close fit of the insert 13 in the member 11 is sufficient to maintain the insert 13 in its place within the member 11 and no means joining the insert 13 to the member 11 need be provided nor is desirable, as slight relative movement between the interfacing surfaces of member 11 and insert 13 is desired during vibration of the roller 10. The insert 13 is preferably of the same material as the member 11 so that problems caused by differences in thermal properties will be avoided.

The end portions 14 of the member 11 are each machined so as to accept, say, a gudgeon or journal member 15 or other conventional means for use in supporting the roller member 11 for rotation about its longitudinal axis. Steps 16 are machined in the end portions 14 for mating engagement with similar steps in the gudgeons, and small spaces 17 between insert 13 and the ends of the gudgeons ensure that the gudgeons are seated properly in the end portions 14. Shafts 18 are fitted within the gudgeons 15; and the shafts 18, which

may be positively driven or idle, are suitably rotatively supported in conventional bearings 19.

In FIG. 3, a conventional coating station 20 is shown employing the improved roller 10. A web 21 is wrapped about the surface 12 of the roller 10 and conveyed past a coating hopper 22 for application of one or more coating layers. Examples of such coating hoppers are disclosed in U.S. Pat. No. 2,761,791; No. 2,761,417; No. 2,761,418; and No. 2,761,419 (the contents of which are hereby incorporated by reference thereto). The material to be coated may be supplied by a tank 23 which is coupled to the hopper 22 by conventional pumps, filters, and metering devices, not shown. A vacuum baffle 24 of the kind described in U.S. Pat. No. 2,681,294 (the contents of which is hereby incorporated by reference thereto) may be used to advantage in combination with the roller 10, as the vacuum baffle substantially prevents air bubbles from being carried by the coating liquid and prevents interruptions in the coating caused by instability in the coating bead.

In the improved rollers according to this invention, vibrations — say, those sympathetically induced, and particularly with respect to the longitudinal axis of the roller — are substantially damped as a result of frictional interaction between the inner surface of the member 11 and the outer surface of insert 13. It is believed that vibration within the roller causes these interfacing surfaces of the insert 13 and member 11 to be displaced differentially such that the vibration waves are not effectively transmitted across that interface and may be damped by interference of such waves in the two members. The improved roller is particularly suited to damping the fundamental bending frequency of vibration, i.e., a vibration wherein there is a maximum amplitude of vibration at the middle of the roller and wherein the ends of the roller serve as the only fixed points of the vibration. Since, as provided by the invention, the insert 13 is positioned in the central portion of the roller where the Vibration amplitude is maximum, the efficiency and therefore the degree of damping is maximum at such point. In other words, with the invention the degree of damping that is provided varies along the whole length of the roller, and such damping is directly proportional to, and in response to, the amount of vibratory flexing that occurs along the length of the roller. The extent of vibration damping provided by the improved roller of the invention may be so remarkably complete that products which in the past could not be satisfactorily coated at particular stations because of the problem caused by vibration(s) as described herein may now be coated such that the coating is substantially free of cross-lines.

While the inner surface of the tubular outer member and corresponding insert are preferably cylindrical in shape, in its broader aspects the invention and the description pertaining thereto are applicable to other shapes, such as that of a prism. Thus, in accordance with the invention, a coating roller having a cylindrical outer surface may include a prismatic insert, say, a rectangular parallelepiped, that is inserted within the hollow of a tubular outer member, which hollow has a shape similar to that of the insert. For optimum results, the insert should be in contact with at least fifty percent

of the inner surface area of the outer member and preferably is dimensioned to a tolerance of ± 0.001 inches of the corresponding transverse cross-sectional dimensions of the hollow.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

What is claimed is:

1. A coating roller for transporting a moving web into contact with a ribbon of coating material discharging from a coating hopper adapted for depositing such coating material onto the web, said coating roller comprising:

a metallic tubular roller member having end portions, a generally-cylindrical outer surface adapted to contact and transport a web, and a generally-cylindrical inner surface defining a cavity between said end portions,

journal means coupled to each end portion of said roller member for mounting said roller for rotation about the axis of its outer surface, and

a metallic tubular insert member positioned within the cavity of said roller member and having a generally-cylindrical outer surface in frictional engagement with at least 50 percent of the inner surface of the roller member to form an interface between said frictionally engaged surfaces that dampens vibration in the roller member.

2. A coating roller for transporting a moving web into contact with a ribbon of coating material discharging from a coating hopper adapted for depositing such coating material onto the web, said coating roller comprising:

a metallic tubular roller member having end portions, a generally-cylindrical outer surface adapted to contact and transport a web, and a generally-cylindrical inner surface defining a cavity between said end portions,

journal means coupled to each end portion of said roller member for rotatably mounting said roller member rotation about the axis of its outer surface, and

a metallic tubular insert member positioned within the cavity of said roller member and having a generally-cylindrical outer surface substantially equal in diameter to the diameter of the inner surface of said roller member and extending axially within the cavity of the roller member such that the outer surface of the insert member is in frictional engagement with at least 50 percent of the inner surface of the roller member to form an interface between said frictionally engaged surfaces that dampens vibration in the roller member.

3. A coating roller according to claim 2 wherein the outer diameter of the insert member is substantially equal to the inner diameter of the roller member within a tolerance of ± 0.001 inch, such that said insert member is held in position in said roller member by a frictional fit.

* * * * *