Sept. 24, 1968 J. L. STOCKING 3,402,656

ROLLER SQUEEGEE

Filed Oct. 13, 1966

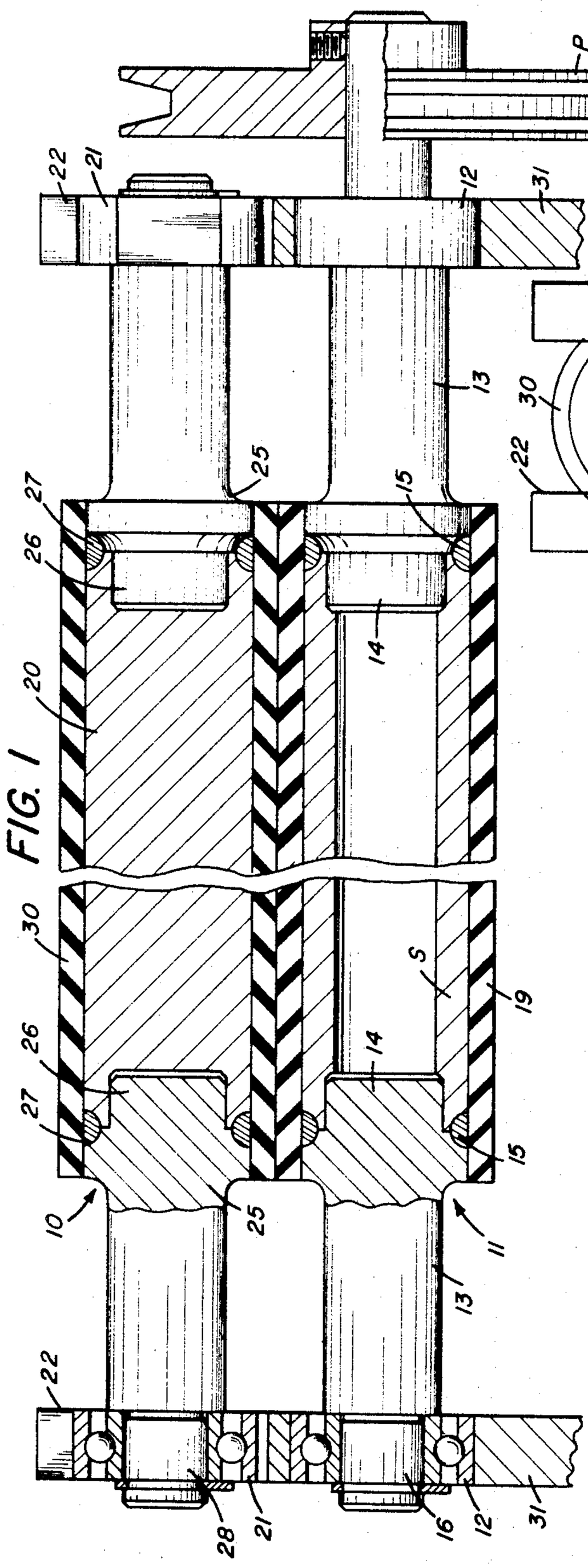


FIG. 1

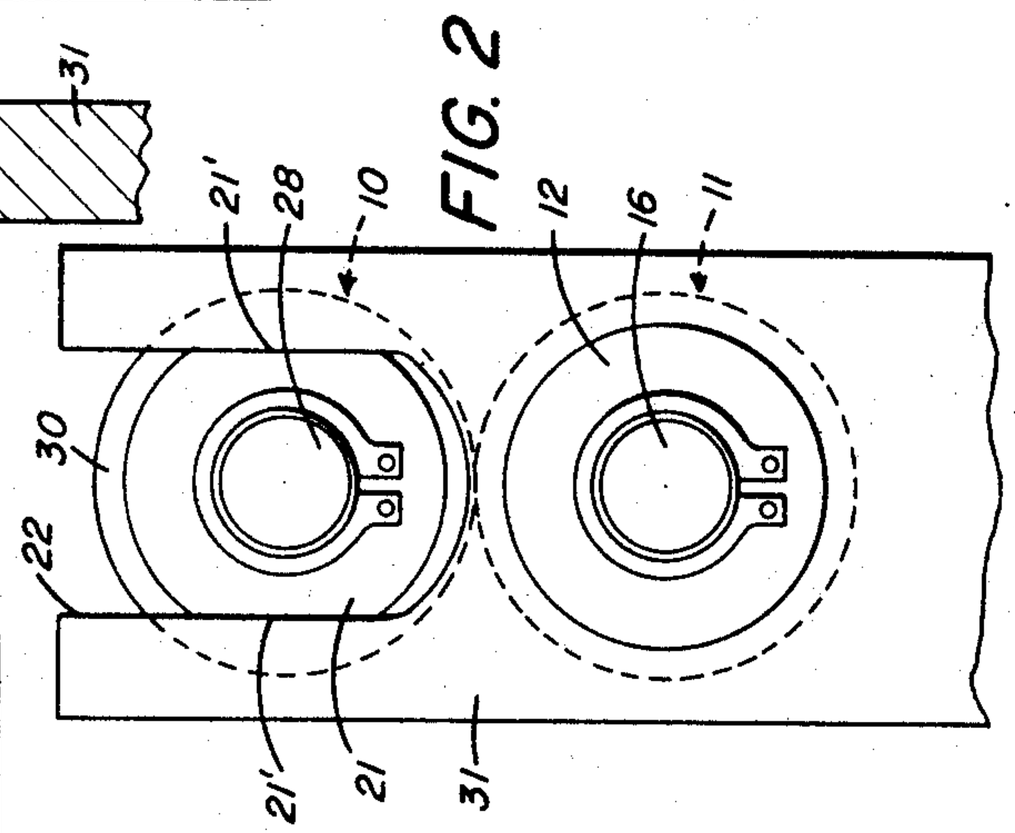


FIG. 2

JOHN L. STOCKING
INVENTOR.

BY Natalie O. Hodson
Paul R. Holmes
Earl T. Thompson
ATTORNEYS

United States Patent Office

3,402,656

Patented Sept. 24, 1968

3,402,656
ROLLER SQUEEGEE

John L. Stocking, Rochester, N.Y., assignor to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey

Filed Oct. 13, 1966, Ser. No. 586,446
5 Claims. (Cl. 100—155)

ABSTRACT OF THE DISCLOSURE

A roller squeegee comprising a fixed bottom roller and a floating upper roller held in contact with the bottom roller, and in which the section modulus to weight ratio of the two rollers is such that the upper roller will deflect under its own weight more than the bottom roller so that uniformity of contact pressure between the rollers is assured not simply by gravity but by the fact that the top roller deflects more under its own weight than the bottom roller.

The present invention relates to an improved roller squeegee for removing a liquid from the surface of wet webs or sheets fed therethrough, and particularly to a roller squeegee for uniformly squeeging a wide strip of film as it leaves a tray of processing liquid.

With squeegee rollers of a length to handle a 42" wide web of film it is difficult to apply pressure at the bearings without the rollers deflecting in such a manner as to cause them to separate at their midpoint. The greater the force applied to the bearings, the greater the separation. However, it is not practical to run a back-up bearing against the rubber roller to prevent such deflection because in time a groove would be worn in the rubber. In photographic processing apparatus cost would prohibit the use of an intermediate metal roller to back-up the squeegee roller to prevent its deflection.

Many elaborate schemes have been devised to eliminate deflection of the rollers of the squeegee in order to obtain a uniform pressure between them throughout their length. U.S. Patent 3,097,590 shows a roller squeegee in which the bearings are mounted on gudgeons extending inwardly from the roller ends and supported by a through shaft. The paper and printing industries customarily use large diameter rollers to reduce the length to diameter ratio.

The roller requirements for a photographic processor in which the present roller squeegee is to be used are uniform squeeging of films up to 42" wide, simplicity and easy removal of the rollers for cleaning. These requirements preclude the use of rollers which have a low length to diameter ratio in order to eliminate their deflection because such rollers would be too heavy and expensive to be used in a photographic processor in which the present squeegee is to be used.

Whereas the prior art has endeavored to prevent the rollers of a squeegee from deflecting along their length in order to obtain a uniform pressure along the entire length of the rollers, the present invention solves this problem by making the two rollers so that they will deflect, but by different amounts, and then arranging them so that their different characteristics result in a uniform contact between the two throughout their length.

The primary object of the present invention is to provide a roller squeegee the rollers of which will provide uniform squeeging action through their length even though they may be up to 45" long and light enough to be lifted out of operative position for cleaning.

Another object is to provide a roller squeegee of the type described which comprises a bottom horizontal rubber covered roller and a top rubber covered roller held

in rolling contact with the top of the bottom roller by its weight alone, and in which the section modulus to weight ratio of the two rollers is such that the upper roller will deflect under its own weight more than the bottom roller so that uniformity of contact pressure between the rollers is assured not simply by gravity but by the fact that the top roller deflects more under its own weight than the bottom roller.

And still another object is to provide a roller squeegee of the type described in which the rubber covering on the top roller has a lower durometer than that of the rubber covering on the bottom roller for the purpose of eliminating the bead of liquid which usually forms on the trailing edge of a film as it leaves the squeegee rollers.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its details of construction and its methods of operation, together with additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIG. 1 is a horizontal elevational view, partly in section, of a roller squeegee constructed in accordance with a preferred embodiment of the present invention, and

FIG. 2 is an end elevational view, looking at the left end of FIG. 1, and showing the bearing mountings for the squeegee rollers.

Referring now to the drawings, the roller squeegee constructed in accordance with a preferred embodiment of the present invention comprises a pair of rubber covered metal rollers **10** and **11** which are horizontally disposed in rolling contact with one another. If the squeegee is to act as a transport means for the wet film as well as a squeegee, then the bottom roller **11** may be driven by any suitable means such as a pulley P.

The bottom roller **11** of the pair is mounted at opposite ends in fixed bearings **12** so that it is basically a simple supported beam. It comprises a hollow metal shaft S which gives the roller a section modulus to weight ratio resulting in a minimum uniform deflection due to its own weight. This roller has a rubber covering **19** thereon. In order to facilitate fabrication of this roller, the rubber covered portion of which may be as great as 45" in length, the bearing ends of this roller may comprise metal plugs **13** one end of which seats in the end of the hollow shaft and is welded thereto as indicated at **15**. The other end **16** of these plugs is turned down to form the bearing ends which seat in fixed bearings **12** mounted in the vertical supports **31** at opposite ends of the squeegee.

The upper roller **10** of the pair comprises a solid metal shaft **20** mounted at opposite ends in bearings **21** having opposed flat sides **21'** and which float in open ended vertical guideways **22** formed in the top of the supports **31** so that they do not support any of the weight of this roller but merely provide vertically movable supports for the roller **10**. This roller has a rubber covering **30**. There is no axial or vertical loading on the bearings **21** and the only purpose of the bearings and guideways **22** is to keep the top roller **10** parallel to the bottom roller **11**. The total weight of the top roller is thus supported by the bottom roller so that any deflection the top roller might have due to its weight is transmitted to the bottom roller. Should it be desired that the bottom roller **11** be removable for cleaning purposes then the bearings **12** therefor could be provided with opposed flat sides like bearings **21** and the vertical guideways lengthened to an extent that the bottom thereof would locate and support the bottom roller **11**.

According to the present invention, the section modulus to weight ratio of the top roller **10** is made much less

than that of the bottom roller **11** so that it will deflect more due to its own weight than will the bottom roller when the two are mounted as shown. Thus, each of the rollers **10** and **11** act as simply supported beams with a uniformly distributed load. Therefore, since the bottom roller supports the top roller, and the top roller has a much lower section modulus to weight ratio than the bottom roller, this results in the uniform squeegee action across the entire effective length of the rollers which may be as much as 45" or more. In order to facilitate construction of the top roller **10**, the bearing ends thereof are made up substantially the same as those of roller **11**, namely they consist of metal plugs **25** seated at one end **26** in a cavity in the end of the solid metal shaft and are connected thereto by a weld **27**, the other end of the plugs being turned down to form the bearing end engaging bearings **21** for the roll.

The operation of this novel roll squeegee is not dependent upon the specific size or weight of the two rollers, but rather upon the relationship of the combination. The weight and diameter of the rollers will ordinarily be determined by such factors as:

(1) Material costs—less material, less cost.

(2) Handling—rollers must be removable for frequent cleaning and maintenance.

(3) The smaller the diameter, the less tendency for the leading edge of film fed between the rollers to follow the periphery of one or the other of the rollers.

In one successful model of the roller squeegee which was built the top roller was made of steel and had an outside diameter of 1⅝". The bottom roller was also made of a steel tube having an outside diameter of 1⅝" and an inside diameter of 1.160". The rubber covering on the two rollers brought their outside diameters up to 2". The effective or rubber covered portions of the two rollers was 45" in length, with the bearings outboard at this point. The top one of these rollers weighed 26 lbs. and the bottom roller 14 lbs. The calculated deflection of the pair of rollers at midpoint was .003".

A second set of rollers which performed equally satisfactorily although of reduced dimensions comprised a solid steel top roller having an outside diameter of 1.25" and, a hollow steel bottom roller having an outside diameter of 1.25" and an inside diameter of .75". The rubber covering on each of these rollers brought their outside diameter up to 1.600". The weights of the top and bottom rollers were 15 and 7 lbs. respectively. The calculated deflection of this pair of rollers at midpoint was .006".

It was also found that if a softer rubber covering is used on the top roller than on the bottom roller, the bead of liquid usually formed on the trailing edge of a wet film leaving the squeegee rollers will be eliminated. For example, in the above second-mentioned example the bottom roller had a neoprene rubber covering of 50 durometer and the top roller had a neoprene rubber covering of 35 durometer. Using a roller squeegee constructed in accordance with this invention it has been found that a uniform pressure can be maintained across a 42" wide film removing the liquids equally from the entire surface with only approximately 7% moisture remaining.

From the above description it will be seen that the present invention solves the problem of obtaining a uniform pressure along the entire length of a pair of squeegee rollers in a manner which is contrary to the prior art approaches for solving this problem. For example, instead of trying to prevent deflection of the rollers in one way or another, e.g. reducing the length to diameter ratio, using complicated and expensive mountings for the rollers, etc. in order to obtain a uniform pressure between them, I have made the rollers to have a section modulus to weight ratio so that they will deflect under their own weight and have used this deflection characteristic of the rollers to assure a uniform pressure contact between them. By this approach rollers having a large length to diameter ratio can be used so that roller squeegees adapted to handle wide webs of material are practical. Furthermore, this approach makes possible the use of rollers which are light enough to be lifted into and out of operative position so that they can be readily removed for cleaning. The floating bearing concept for the top roller of this novel squeegee also lends itself to ready removal of the top roller for cleaning and maintenance purposes. The advantages of the present invention over the prior art will be most readily appreciated if one imagines what the size and weight of the rollers of a squeegee capable of handling a 42" wide sheet might be if the length to diameter ratio of the rollers was reduced sufficiently to make the rollers so rigid that they would not have a deflection regardless of whether they were mounted so that their bearings are loaded or so that the top roller floats as in the present roller squeegee.

While I have shown and described specific embodiments of my invention, I am aware that many modifications thereof are possible. My invention, therefore, is not to be limited to the precise details shown and described but is intended to cover all modifications coming within the scope of the appended claims.

I claim:

1. A roller squeegee comprising in combination,

a first horizontal rubber covered metal roller journalled at opposite ends in fixed bearings, said roller having a relatively large length to diameter ratio and a given section modulus to weight relation such that it will deflect a given amount along its length due to its own weight, and

a second rubber covered metal roller journalled at opposite ends in floating bearings to rest in rolling contact atop said first roller due to gravity, this roller being substantially the same length as said first roller and having a section modulus to weight relation less than that of said first roller so that it is capable of a greater deflection along its length due to its weight than said first roller to assure uniformity of contact pressure between said rollers throughout the length of contact of said rollers.

2. A roller squeegee according to claim **1** in which said first metal roller is a hollow steel shaft and said second metal roller is a solid steel shaft.

3. A roller squeegee according to claim **1** in which each of said metal rollers are of substantially the same outside diameter and said upper roller is approximately twice as heavy as said lower roller.

4. A roller squeegee according to claim **1** in which the rubber covering on the upper roller is softer than the rubber covering on the bottom roller to eliminate the bead of liquid usually formed on the trailing edge of a wet web as it leaves the squeegee rollers.

5. A roller squeegee according to claim **1** in which the outside diameter of the two rollers is substantially the same and less than two inches.

References Cited

UNITED STATES PATENTS

209,954	11/1878	Bicknell	100—176
1,758,326	5/1930	Langsner.	
2,380,550	7/1945	Reed	15—77 X
3,000,287	9/1961	Heldens	98—89
3,097,590	7/1963	Justus	100—155
3,146,160	8/1964	Kankaanpaa.	

FOREIGN PATENTS

1,377,044	9/1964	France.
348,946	11/1960	Switzerland.

LOUIS O. MAASSEL, *Primary Examiner.*