July 14, 1942. J. G. CAPSTAFF 2,289,753

AIR SQUEEGEE

Filed June 17, 1939

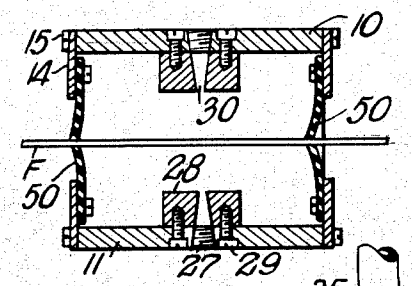


FIG. 4

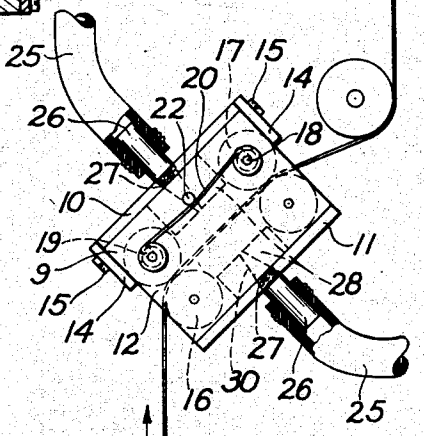
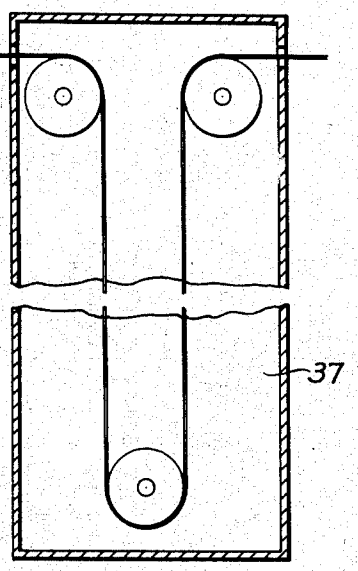


FIG. 1



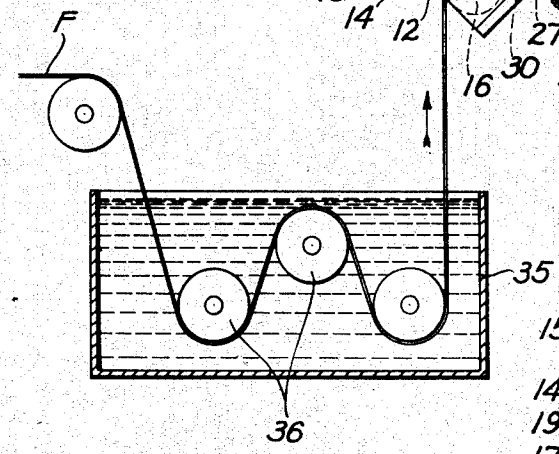


FIG. 2

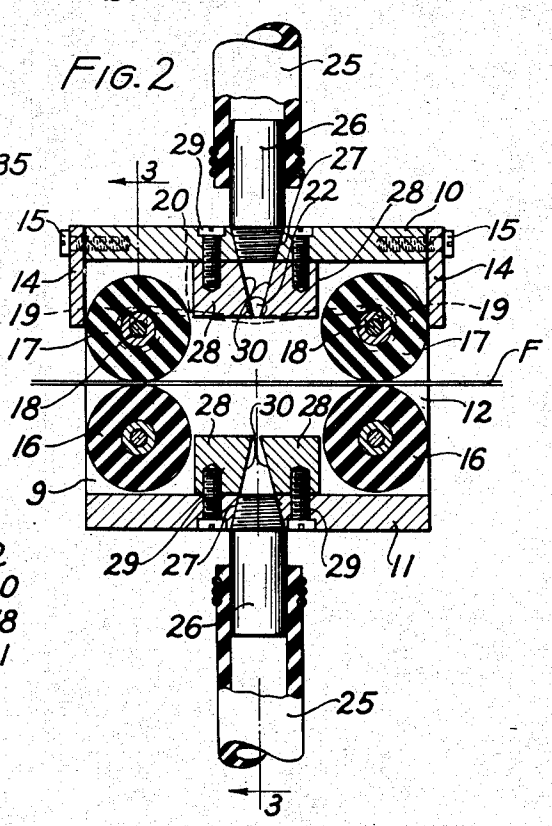
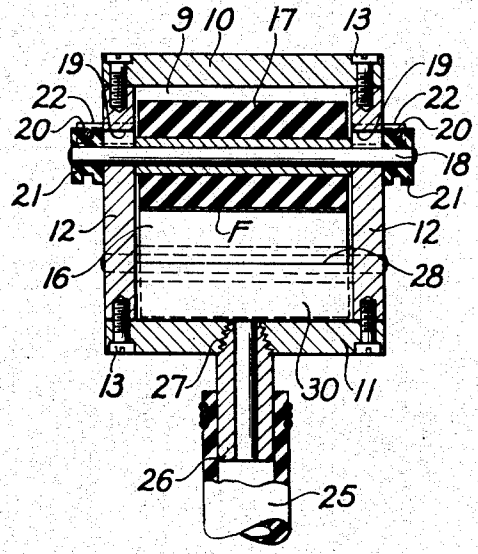


FIG. 3



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AIR SQUEEGEE

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10 Claims. (Cl. 15—20)

The present invention relates to air squeegees, and particularly to an air squeegee through which a web leaving a liquid treating bath may be passed to have the excess moisture effectively removed from both surfaces thereof prior to its passage into a dryer.

The present invention is particularly adapted for use in conjunction with motion picture film treating apparatus, and for removing the excess treating liquid from the surfaces of the film after treatment before it is submitted to the drying operation. However, it is pointed out, and will be readily understood, that the same is not limited to use with motion picture film, but can be used to remove excess moisture from the surfaces of a continuous web of any material, and after treatment where such web is passed through a liquid so as to accumulate an excess on its surfaces which must be removed.

Air squeegees of one type or another are commonly used for the purpose of removing excess liquid from the surfaces of a web which has been treated with a liquid. The known type of air squeegees, however, use the exposed type of air nozzle for causing the impingement of air onto the web, and which type of air squeegee depends upon the nozzle being directed at an angle to the approaching web in order that the air impinging on the web surfaces will remove the liquid therefrom. It has been found that air squeegees of the type using exposed nozzles are very noisy and wasteful of air, and also that when the web is moved at relatively high speed several air nozzles or jets of air are required to effectively remove the excess liquid from the surfaces thereof.

Therefore, one object of the present invention is to provide an air squeegee for the purpose of removing excess liquid from the surfaces of a web passing therethrough, and which is more quiet and uses less air than air squeegees of the known type. Another object is to provide an air squeegee in which the air nozzles are not exposed and need not be directed at an angle to the approaching web. And a further object is to provide an air squeegee which comprises a substantially closed chamber into which air under pressure is directed, and having a restricted entrance and exit through which the web is adapted to pass; and which restricted entrance and exit in combination with the web passing therethrough control the release of air from the chamber so as to effectively remove the excess of liquid from the web surfaces. And yet another object is to provide an air squeegee which will remove the liquid from a film effectively at high speeds of movement as well as at low speeds. And another object is to provide an air squeegee for the purpose mentioned which is simple in construction and effective in operation.

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 organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawing in which,

Fig. 1 is a side elevation of the air squeegee, partly in section, and showing how the same might be used in conjunction with a film treating apparatus,

Fig. 2 is a longitudinal section of the air squeegee, and showing the preferred embodiment of the same, and

Fig. 3 is a section taken substantially on line 3—3 of Fig. 2.

Fig. 4 is a longitudinal section on a reduced scale, and showing the ends of the chamber closed by flexible flaps instead of rollers as in the preferred embodiment.

Like reference characters refer to corresponding parts throughout the drawing.

Referring now to the drawing, and particularly to Figs. 2 and 3, my air squeegee comprises a chamber, indicated generally as 9, which may include a top 10, a bottom 11, and spaced side walls 12, which may be assembled from individual parts held together by screws 13, or which may be formed in any suitable manner. The ends of the chamber are completely open with the exception of the upper parts which are closed by plates 14 fastened to the ends of the top 10 by screws 15, and for the purpose hereinafter pointed out.

At each end, and in the lower half, of the chamber 9 is rotatably journaled a roller 16 which extends substantially from side wall to side wall of the casing, leaving only enough clearance to permit rotation of the roller. Rotatably mounted in the chamber 9 in vertical alignment with rollers 16 are rollers 17, and which rollers are preferably of the same size as rollers 16. The film F passes between each pair of rollers in passing into and out of the chamber, and to prevent marring or abrasion of the film the rollers are preferably made of rubber, but other suitable flexible material may be used. The upper rollers 17 have their axles 18 extending through elongated slots 19 in the side walls 12 of the chamber so that they can move vertically relative to

the lower rollers 16 to accommodate for film splices.

The upper rollers 17 are normally spring pressed toward the lower rollers 16 by springs 20 located on opposite side walls 12 of the chamber 9. Either end of each spring 20 engages a grooved collar 21 fixed to the ends of the axles 18 extending beyond the side walls 12, and the intermediate portion of each spring 20 is snapped under a stud 22 which extends from the side wall 12 and is located thereon in vertical relation to the axles 18 whereby the springs are tensioned when snapped thereunder. While any number of suitable means may be employed for normally pressing the rollers 17 toward the rollers 16, the described arrangement provides one which permits ready release of the pressure for threading purposes or the like. By merely snapping the spring 20 from under the stud 22, or off one of the groove collars 21, the spring tension is released.

The rollers 16 and 17 may be so mounted in the chamber as to be in rolling contact, or if it is desired to reduce the pressure on the film at this point the slots 19 may be so located in the side walls that the peripheries of the rollers will be slightly spaced when the axles 18 are at the bottom of the slots, see Fig. 3, such spacing of course never being substantially greater than the thickness of the film F. As will be noticed by referring to Fig. 2, the clearance between the rollers 16 and the bottom of the chamber, and the clearance between the rollers 17 and the plate 14 are made as slight as possible so that air leakage around the rollers at these points is kept at a minimum. Therefore, each pair of rollers 16 and 17 may be considered as substantially closing each open end of the chamber 9.

Air under pressure is introduced into the chamber 9 intermediate each pair of rollers 16 and 17, and on each side of the film F, through air hoses 25 connected to a suitable air supply, not shown. Each of these air hoses 25, which may be flexible, are slipped over a nipple 26 threaded into a tapped opening 27 in both the top and bottom of the chamber. To the inner face of both the top and bottom of the chamber 9 blocks 28 are fixed on opposite sides of the opening 27 by screws 29. Each of these blocks 28 has an inclined face 30 and these faces taper from the sides of the opening 27 toward one another to form a nozzle which increases the velocity of the air entering the chamber and serves to distribute and direct it against one side of the film and across the entire width thereof. These blocks 28 extend completely across the chamber from side wall to side wall so that the entering air is changed from a jet to a sheet extending across the width of the web whereby even distribution of air is achieved. The air may be directed into the chamber from any point so long as it is intermediate each pair of rollers 16 and 17, and need not be directed downward onto one or both surfaces of the film. However, the disclosed arrangement has been found to give very satisfactory results, and has, therefore, been chosen to illustrate one manner of carrying out the invention. The blocks 28, it will be noted, are brought as close to rollers 16 and 17 as possible in order to cut down the air leakage from the chamber around the outside of these rollers. It will be readily appreciated that the present invention is not limited to the use of nozzles constructed as disclosed, but this type of nozzle has been found to be satisfactory, and much more important, very cheap to manufacture as well as easy to assemble. As a matter of fact, the only real need for the nozzle is to direct the incoming air below the tops of the rollers 17 to eliminate the escape of air around the tops thereof, so that suitable baffle plates, or a packing, could be used at these points and the nozzzle could be eliminated without defeating the result or purpose of the air squeegee.

The air which is introduced into the chamber 9 under pressure must escape at some point, and this point of escape is between the rollers 16, 17, and the surfaces of the film F whereby the moisture on the surfaces of the film is blown off thereof upon entering the chamber. The amount of air which escapes around the outside of the rollers 16 and 17 has been found to be negligible, and has also been found to keep the rollers clean and dry. It might be pointed out that the chamber 9 is of such size that the side walls 12 thereof are spaced apart only a slightly greater distance than the width of the film so that air leakage from the chamber at the sides of the film is negligible. Since the rollers 16 are quite light in weight and the pressure induced thereon by the springs 20 is only slight it has been found that the air will actually raise these rollers slightly to permit it to escape. It has also been found that the flexible rollers are actually deformed by the air pressure at the point of escape so as to provide a clearance between the rollers and the film through which the air in the chamber may escape with great velocity to blow the liquid from the film surfaces. It has been found that practically all of the liquid is blown off of the film before it enters the chamber 9 so that the escape of air at the exit of the chamber has no squeegeeing to do. The exit cannot be tightly closed, however, because the film must have an exit through which it can pass without being marred or abraded. Different film speeds can be readily accommodated by increasing or decreasing the pressure of the air introduced into the air chamber 9.

While rollers have been disclosed as providing an entrance and exit to the air chamber, it is pointed out that the invention is not limited to the use thereof. Any suitable arrangement which would restrict the escape of air from the chamber to the film surfaces, and still permit passage of the film therethrough, would be suitable. Such an arrangement is shown in Fig. 4 as comprising a pair of flexible flaps 50 fixed to each end of the chamber in such a way as to provide a restricted opening between themselves through which the film can pass and between which and the surfaces of the film passing therebetween air can escape from the chamber.

Referring now to Fig. 1 where the application of my novel air squeegee is shown, it will be noticed that the same is located between the last film treating tank 35, which usually contains water, and the film dryer 37. The film F may be fed through the treating tank 35 in the direction indicated by the arrow, over rollers 36, from whence it is fed through the air squeegee to have the liquid removed from the surfaces before passing into the dryer 36 where it is completely dried. It will be noticed that the air squeegee is located at an angle to, and vertically above, the treating tank 35 so that the liquid blown from the film by the squeegee will drop back into said tank.

From the above description it will be appreciated that my novel air squeegee is one which wastes the least amount of air, and is more

quiet than known squeegees of this type because no exposed nozzles are used. This air squeegee is not dependent upon any particular nozzle adjustment for its most effective operation, as is the prior art where the angle of exposed nozzles relative to the film path must be critically adjusted, but is ready for efficient operation when the film is threaded therethrough. In addition, this squeegee is simple in construction, cheap to manufacture, and can accommodate different web speeds merely by changing the pressure of the air being introduced into the air chamber.

Although I have shown and described a certain specific embodiment of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except in so far as is necessitated by the spirit of the appended claims.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. An air squeegee comprising a chamber through which a web of material to be dried is adapted to pass, means forming an entrance and an exit in spaced relation in said chamber, and through which said web is directed into and out of said chamber, said entrance and exit each restricted in size whereby the width and length thereof are substantially equal to the width and thickness, respectively, of the web passing therethrough, and means for directing air under pressure into said chamber intermediate said entrance and exit, said entrance and exit forming means being so constructed and arranged to yield under pressure in the chamber to enlarge the entrance and exit whereby said air is adapted to pass out of said chamber through said entrance and exit at high velocity and over the surfaces of the web passing therethrough to produce a wiping action of air along the web.

2. An air squeegee comprising a chamber through which a web of material to be dried is adapted to pass, means forming an entrance and an exit in opposite walls of said chamber and through which said web is directed into and out of said chamber, said entrance and exit each restricted in size whereby the width and length thereof are substantially equal to the width and thickness, respectively, of the web passing therethrough, and means for directing air under pressure into said chamber intermediate said entrance and exit and on opposite sides of the web passing therethrough, said entrance and exit forming means being so constructed and arranged to yield under pressure in the chamber to enlarge the entrance and exit whereby said air is adapted to pass out of said chamber through said entrance and exit at high velocity and over the surfaces of the web passing therethrough to produce a wiping action of air along the web.

3. An air squeegee comprising an open ended chamber through which a web of material to be dried is adapted to pass, a pair of flexible members in surface contact and located at and closing each end of said chamber, and between each pair of which said web passes in passing into and out of said chamber, and means for directing air under pressure into said chamber intermediate the ends of said chamber and onto opposite sides of the web passing therethrough, said flexible members being so constructed and arranged that said air due to the pressure built up in the chamber is adapted to deform each of said flexible members at their point of contact with the web and pass from the chamber between said members and web with a high velocity to produce a wiping action of air along the web.

4. An air squeegee comprising a chamber through which a web of material to be dried is adapted to pass, said chamber including a bottom and top in spaced relation, side walls spaced substantially equal to the width of said web, and open ends in spaced relation, a pair of flexible rollers in vertical alignment at each end of said chamber and closing the same, said rollers of each pair spaced from one another so that their circumferences are separated by an amount substantially equal to the thickness of said web to form an entrance and exit for said chamber through which said web passes into and out of said chamber, and means for directing air under pressure into said chamber intermediate each of said pairs of rollers and on opposite sides of said web, said rollers being so constructed and arranged that said air due to the pressure built up in the chamber is adapted to deform the rollers at their point of contact with the web and pass from the chamber between said rollers with a high velocity to produce a wiping action of air along the web.

5. An air squeegee comprising a chamber through which a web of material to be dried is adapted to pass, said chamber including a bottom and top in spaced relation, side walls spaced substantially equal to the width of said web, and open ends in spaced relation, a pair of flexible rollers in rolling contact and located at each open end of said chamber to close the same, and form an entrance and exit in said chamber through which said web passes in passing into and out of said chamber, and means for directing air under pressure into said chamber intermediate each pair of rollers and on opposite sides of the web passing therethrough, said means including a nozzle in both the top and bottom of said chamber, said rollers being so constructed and arranged that said air due to the pressure built up in the chamber is adapted to deform the rollers at their point of contact with the web and pass from the chamber between said rollers with a high velocity to produce a wiping action of air along the web.

6. An air squeegee comprising a chamber through which a web of material to be dried is adapted to pass, said chamber including a bottom and top in spaced relation, side walls spaced substantially equal to the width of said web, and open ends in spaced relation, a pair of vertically aligned flexible rollers in rolling contact and located at each open end of said chamber to close the same, and to form an entrance and exit through which said web is adapted to pass in passing into and out of said chamber, and a nozzle in both the top and bottom of said chamber intermediate each pair of rollers and through which air under pressure may be directed into said chamber, the upper roller of each pair mounted in said chamber to move to and from its companion roller and arranged so that said air due to the pressure built up in the chamber is adapted to force said movable rollers from their companion rollers and pass from the chamber between said rollers and the web with a high velocity to produce a wiping action of air along the web.

7. An air squeegee comprising a chamber through which a web of material to be dried is

adapted to pass, said chamber including a bottom and top in spaced relation, side walls spaced substantially equal to the width of said web, and open ends in spaced relation, a pair of flexible rollers mounted in rolling contact in said chamber adjacent each open end thereof to close the same, and between which said web is adapted to pass in passing into and out of said chamber, means for mounting one roller of each pair in said chamber whereby it is adapted to move to and from its said companion roller, said means comprising an axle for said movable roller both ends of which extend through elongated slots in said chamber, means for normally moving said movable roller into rolling contact with its companion roller, and a nozzle in both the top and bottom of said chamber intermediate each pair of rollers and through which air under pressure may be directed into said chamber, said air due to the pressure built up in the chamber adapted to force said movable roller from its companion roller and pass from the chamber between said rollers and the web with a high velocity to produce a wiping action of air along the web.

8. An air squeegee comprising a chamber through which a web of material to be dried is adapted to pass, said chamber including a bottom and top in spaced relation, side walls spaced substantially equal to the width of said web, and open ends in spaced relation, a pair of flexible rollers mounted in rolling contact in said chamber adjacent each open end thereof to close the same, and between which said web is adapted to pass in passing into and out of said chamber, means for mounting one roller of each pair in said chamber whereby it is adapted to move to and from its said companion roller, said means comprising an axle for said movable roller both ends of which extend through elongated slots in said chamber, means for normally moving said movable roller into rolling contact with its companion roller, said means including a stud extending from each side of said chamber between each of said movable rollers and located out of alignment with the axles of said movable rollers, and an elongated spring member having either end thereof engaging that side of each axle removed from the companion roller of the roller mounted thereon, each of said spring members having its middle portion snapped under one of said studs, means for sealing said elongated slots against the passage of air from said chamber, and means for directing air under pressure into said chamber intermediate each pair of rollers and on opposite sides of said web, said air due to the pressure built up in the chamber adapted to force said movable roller from its companion roller and pass from the chamber between said rollers and the web with a high velocity to produce a wiping action of air along the web.

9. An air squeegee comprising an open ended chamber through which a web to be dried is adapted to pass, a pair of flexible rollers in rolling contact located at and closing the ends of said chamber, and between which said web is adapted to pass in passing into and out of said chamber, one roller of each pair mounted whereby it is adapted to move relative to its companion roller for accommodating webs of different thickness, and means for directing air under pressure into said chamber and on opposite sides of said web passing therethrough, said means including providing both the top and bottom of said chamber with a threaded opening, a nipple threaded into each of said openings and to each of which an air line may be attached, and a nozzle fixed to the inside face of both the top and bottom of said chamber in alignment with the opening therein for increasing the velocity of the air entering said chamber and for directing said air against opposite sides of said web passing therethrough, said air due to the pressure built up in the chamber adapted to force said movable roller from its companion roller and pass from the chamber between said rollers and the web with a high velocity to produce a wiping action of air along the web.

10. An air squeegee comprising an open ended chamber through which a web to be dried is adapted to pass, a pair of flexible rollers in rolling contact located at and closing the ends of said chamber, and between which said web is adapted to pass in passing into and out of said chamber, one roller of each pair mounted whereby it is adapted to move relative to its companion roller for accommodating webs of different thickness, and means for directing air under pressure into said chamber and on opposite sides of said web passing therethrough, said means including providing both the top and bottom of said chamber with a threaded opening, a nipple threaded into each of said openings and to each of which an air line may be attached, and a nozzle fixed to the inside face of both the top and bottom of said chamber in alignment with the opening therein for increasing the velocity of the air entering said chamber and for directing said air against opposite sides of said web passing therethrough, each of said nozzles including a pair of blocks having one inclined face, each of said blocks fastened to the top or bottom of said casing on opposite sides of said opening therein and with their inclined faces tapering from opposite sides of said opening toward one another, said air due to the pressure built up in the chamber adapted to force said movable roller from its companion roller and pass from the chamber between said rollers and the web with a high velocity to produce a wiping action of air along the web.

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