Feb. 17, 1953 J. F. CRAIB 2,628,834

WEB FEEDING MECHANISM FOR PHOTOGRAPHIC APPARATUS AND THE LIKE

Filed May 3, 1948 3 Sheets-Sheet 1

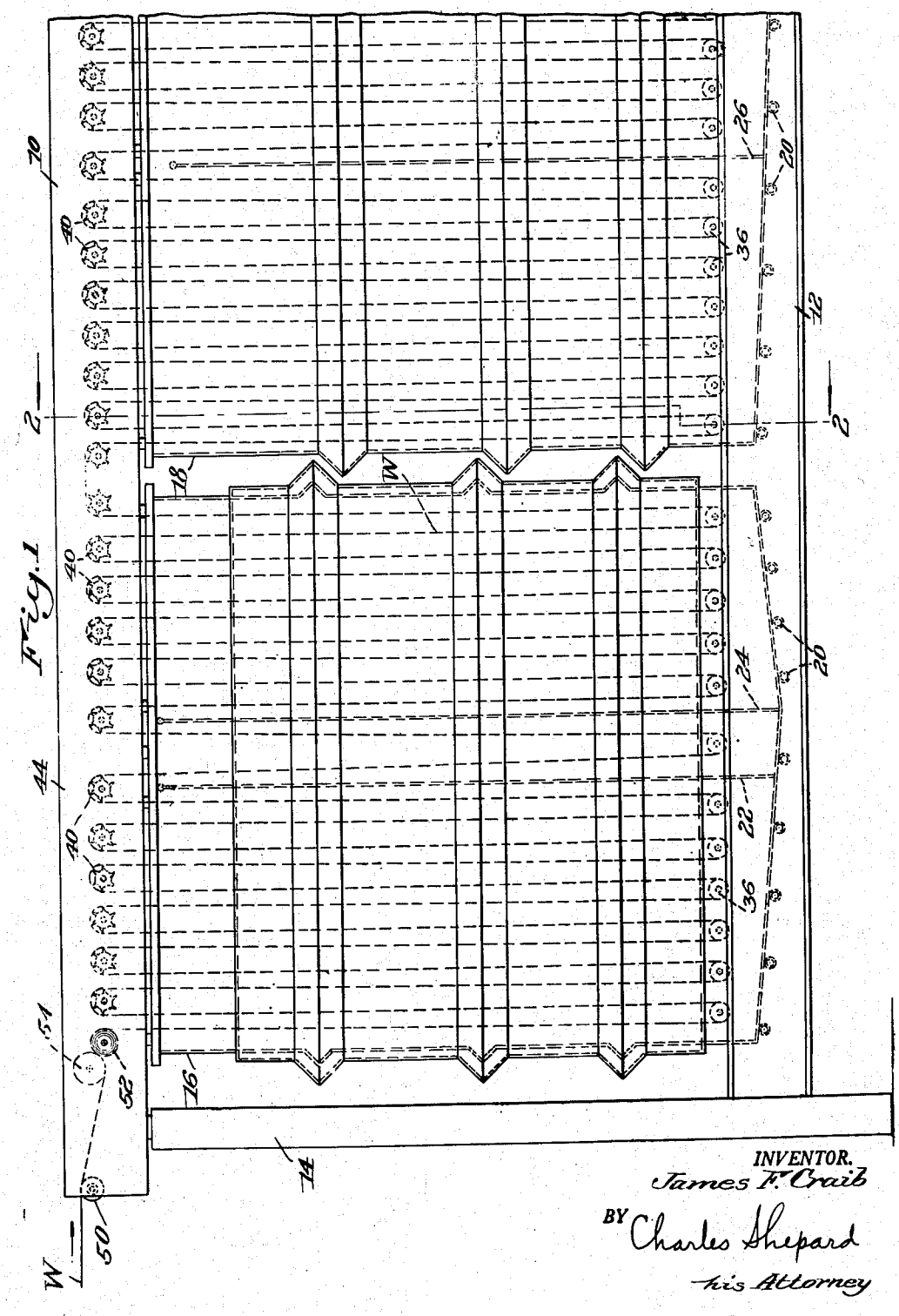

Fig. 1

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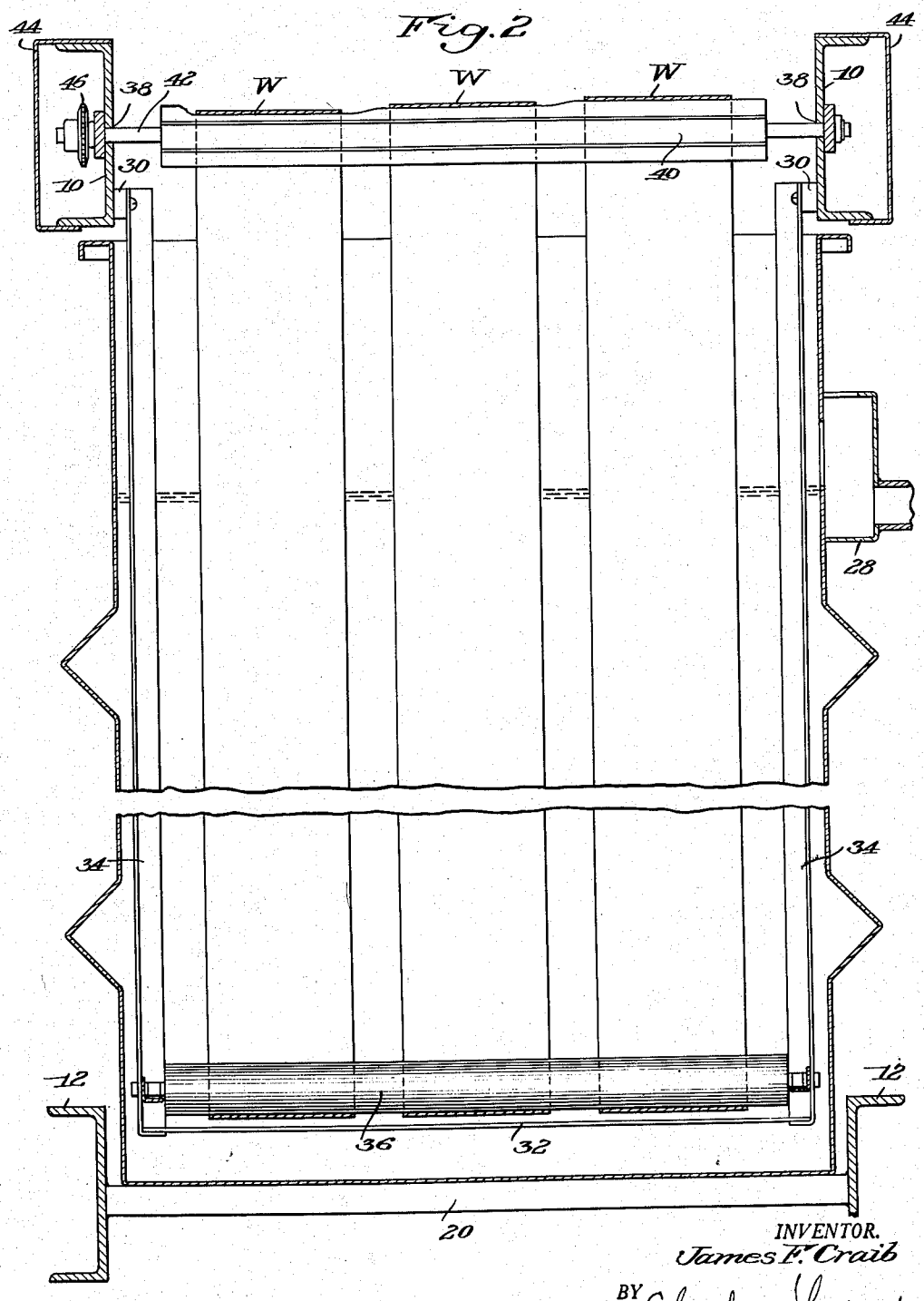
Filed May 3, 1948 3 Sheets-Sheet 2

Fig. 2



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Filed May 3, 1948 3 Sheets-Sheet 3

Fig. 3

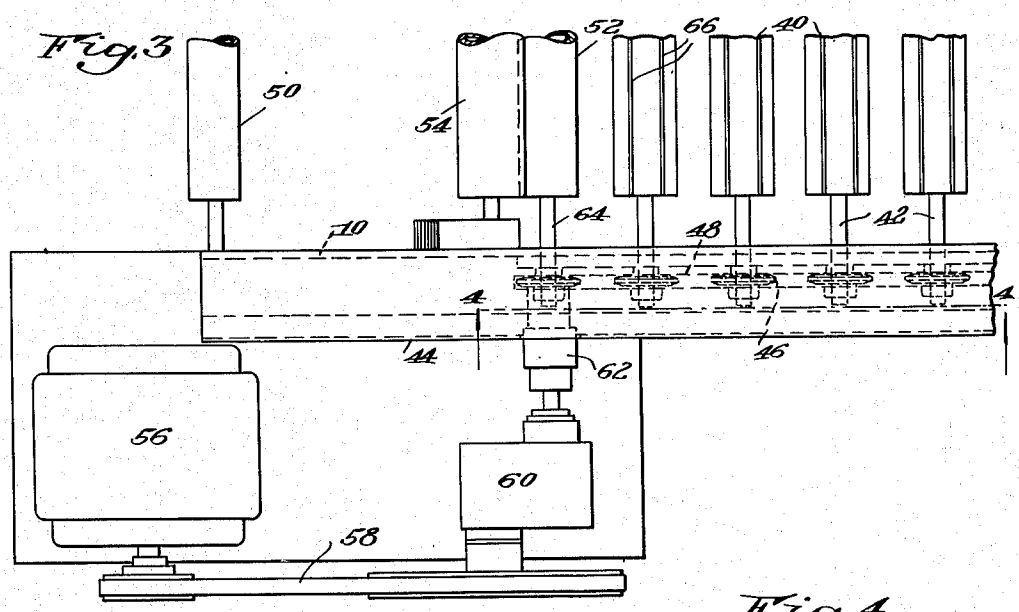


Fig. 4

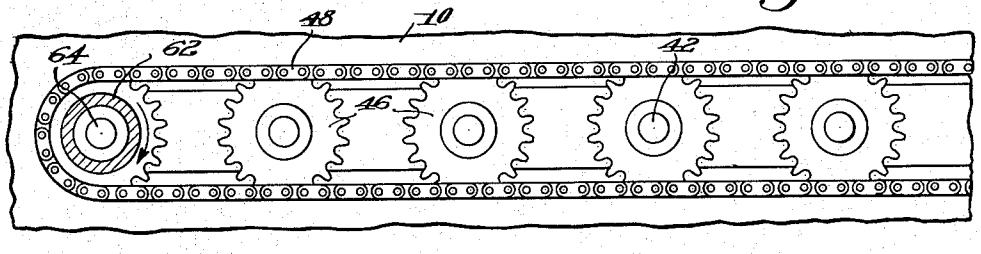


Fig. 5

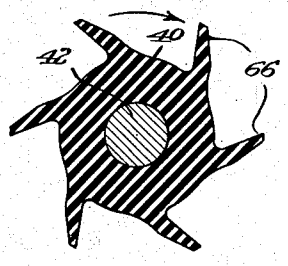


Fig. 6

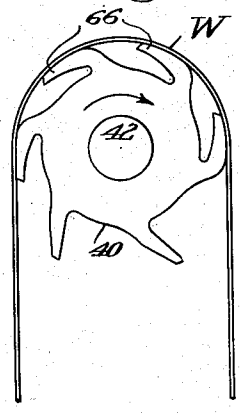
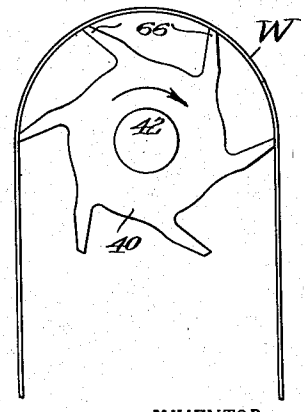


Fig. 7



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Patented Feb. 17, 1953 2,628,834

UNITED STATES PATENT OFFICE

2,628,834

WEB FEEDING MECHANISM FOR PHOTOGRAPHIC APPARATUS AND THE LIKE

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Application May 3, 1948, Serial No. 24,734

4 Claims. (Cl. 271—2.3)

1

The present invention relates to web feeding and conveying and more particularly to the driving of a continuous web product through a liquid bath or baths or otherwise conducting its progress while in a saturated condition and it has for its general object to provide a simple, durable and efficient apparatus for accomplishing this purpose in a manner whereby the web is caused to advance at a uniform rate at all stages and throughout its length even though, in the meantime, it may be either shrinking or stretching.

A further object of the invention is to provide such an apparatus that will be capable of feeding a plurality of continuous webs together and side by side over and through the same conducting means with a desired uniform tensile strain on each and all even though the degree of linear expansion and contraction on the part of the individual webs may vary under the same treatment.

A still further object of the invention is to accomplish these results by means of a direct frictional drive against the surface of the web itself by devices that also support it in taut stretches and still compensate for linear variations.

These and other desirable objects are accomplished by the construction disclosed as an illustrative embodiment of the invention in the following description and in the accompanying drawings forming a part hereof, in which:

Fig. 1 is a fragmentary side elevation of the entry end of a web treating and feeding machine constructed in accordance with and illustrating one embodiment of this invention;

Fig. 2 is a vertical section on the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a fragmentary top plan view of the motor gearing for the chain drive of the web feeding mechanism;

Fig. 4 is a fragmentary, vertical section on the line 4—4 of Fig. 3;

Fig. 5 is a detail cross section of one of the feed rolls or units;

Fig. 6 is a diagrammatic end view of a feed unit and a web fragment engaged therewith, illustrating the compensating behavior of the latter under one condition; and

Fig. 7 is a similar view illustrating the behavior of the unit under another condition.

The same reference numerals through the several views indicate the same parts.

As one example of the application of the invention to the useful arts it has been illustrated as embodied in a photographic print treating machine. In the developing, washing, and fixing operations of such a machine it is frequently desired to run a plurality of coated paper webs side by side in vertical loops through successive baths to the final drier. As the paper becomes more and more saturated it stretches progressively and yet it is desired that the reaches of the loops between upper and lower supports be maintained gently taut so that they may be run compactly close together and yet not interfere or touch each other. Obviously the whole length of wet web cannot be drawn through the machine by its advancing end, yet that end must travel more rapidly than the initial feed end when the film is dry because the film, with saturation, stretches progressively as it advances and is longer when it emerges than when it enters the machine. If the feeds were the same the extra length would accumulate in the tanks, causing a confused disposition of the reaches of the loops, resulting in undesirable contacts and other complications. With the present invention the feeding impulses communicated to the film or web increase progressively yet automatically at successive loop supports according to the tension on the web so that just enough tension is maintained and the reaches or falls of the loops in the liquids are maintained flat and out of contact with each other. Yet this is done without the use of any differential speed driving mechanism, which would be complicated and expensive.

2

Referring more particularly to the drawings, 10 and 12 indicate the upper and lower rails of a supporting frame 14 for tanks 16 and 18, the former of which is the initial receptacle and the latter of which, partly shown, is one of a continuing series. These tanks rest on bottom cross rods 20 at the rails 12. Tank 16 is jacketed and there are other formations such as partitions 22, 24, and 26 which divide the first tank into three bath compartments and the second into two, but such matters are immaterial to the present invention. A liquid level shown in Fig. 2 is maintained by suitable overflow connections 28.

Secured to the upper rails 10 at 30 and connected below at 32 are depending hangers 34 carrying bearings for a horizontal series of equally spaced, parallel idle rolls 36 near the bottom of each tank. The upper rails 10 provide bearings 38 for a coextensive series of drive rolls 40 also horizontally arranged, the projecting ends of the shafts 42 of which are housed within the rail channels by cover plates 44. One set of these shaft ends are provided with sprockets 46 over all of which runs a

sprocket chain 48 so that all of the feed rolls are driven together at a uniform rate.

The webs W of film or paper (usually the latter, in the preferred use of the machine) are drawn from a suitable source, such as a supply reel (not shown) and enter the apparatus from the left of Fig. 1 over a guide roll 50 and then pass between an initial smooth-surface feed and metering roll 52 which is positively driven, and its associated contact roll 54 which is an idler roll. Two or more separate webs may be fed through the machine at the same time, three being here shown as an example. After passing the feeding and metering rolls 52, 54, they thence are looped back and forth between the further feed or impelling rolls 40 at the tops and the idle rolls 36 at the bottoms of the tanks so that their reaches are flat, substantially parallel, and as close together as is feasible with respect to the nature of the baths through which they thus pass. The initial feed roll 52 is driven at a suitable speed by a motor 56, belt 58, reduction gearing 60, and a coupling 62 on the shaft 64 of this roll. The other feed rolls 40 are all driven at the same rotary speed by the chain 48 which passes over and is driven by a sprocket on the shaft 64, and which in turn drives all of the sprockets 46 on the shafts 42 of the rolls 40.

The driving and repeated immersions of the web through the various baths is a usual procedure with ordinary feeding and impelling rolls in the position of the present rolls 40. With the usual equipment, however, and as first explained, the webs in a photographic developing machine, at least, are dry at the initial roll 52 but, before they have progressed far they increasingly stretch or expand so that there is a greater length of web to be fed out of the exit end of the machine than the length of web introduced into the entrance end.

In the practice of the present invention, this increasing length of the web is accommodated by constructing the individual feed rolls in a manner best shown in Figs. 2, 3, and 5 to 7. They are preferably of pliable rubber and their only contact with the film web is taken by a plurality of longitudinally extending tapered ribs 66 which project roughly tangentially from the main body of the roll and which are relatively easily bendable and resilient laterally, toward and away from their shafts 42. When viewed in cross section as in Fig. 5, it is seen that the central plane or median plane of each rib is roughly tangential to the basic diameter of the roll; that is, the diameter of the part of the roll between successive ribs. The rolls are driven in the direction of the arrows in Figs. 6 and 7, and the ribs extend obliquely in a trailing direction rather than a leading direction, as is seen from those figures.

The ribs tend resiliently to expand to their initial or undeformed shape shown in Fig. 5, but any substantial tension or tautness in the web passing over a roll will cause the ribs on that roll to bend inwardly to a greater or lesser extent (depending on the degree of tension) as indicated diagrammatically in Fig. 6, thus decreasing the effective diameter of that roll and slowing down the rate of feeding the web past that roll until the tension on the web is decreased (by reason of the slowing down of the feed), whereupon the ribs may be able to expand outwardly somewhat. Thus these feed rolls 40 automatically vary their effective diameters (and thus their feeding speeds) in accordance with the tension or tautness of various portions of the web passing over the various successive feed rolls.

An important feature of this invention is the relation of diameter of the metering roll 52 to the diameters of the feed rolls 40. The smooth-surface metering roll has a diameter which is substantially less than the maximum effective diameter of the feed rolls 40 when their ribs 66 are fully extended to their normal undeformed shape, but slightly greater than the minimum effective diameter of the feed rolls when their ribs are fully folded over as far as they will fold or compress as a result of a reasonable degree of tension within the strength limits of the paper or other web material. Hence when a web is introduced into the machine, the first few feed rolls 40 will immediately try to feed the web faster than the metering roll 52 will allow it to travel, so that a tension will immediately be created, which will deform or bend over the ribs 66 on the first few feed rolls 40 until their effective diameters and feeding speeds are equal to those of the metering roll 52. The ribs on the first few feed rolls will be in approximately the positions illustrated in Fig. 6.

As the web progresses through the machine, however, and becomes increasingly saturated by the liquid baths, it expands in length, which decreases the longitudinal tension in the web, which in turn allows the ribs to expand to increase the effective diameter of the feed rolls over which the web passes after such expansion, so that the rolls automatically accommodate themselves to the increasing length of the web and will properly feed the web out of the machine without allowing any accumulation of slack in the machine, even though the length of the web as it issues from the machine is greater than the length of the web as it is fed into the machine.

Throughout that portion of the machine in which the web is undergoing its longitudinal expansion, each successive feed roll will ordinarily have its ribs or fins expanded or distended to a slightly greater extent than those of the next preceding feed roll. When the web has attained its maximum linear expansion, then all the succeeding feed rolls over which it passes will, of course, have their ribs or fins distended to substantially the same extent.

Another noteworthy feature of the invention is that different webs having different expansion characteristics may be fed through the machine in close laterally-spaced relation to each other, yet each of them will be properly and efficiently fed just as though it were the only web in the machine. This results from the fact that the rubber fins or ribs are so resilient that even maximum distortion or displacement of a fin at one point in the length of a feed roll does not cause any distortion or displacement of the same fin at a point spaced more than about ¾ of an inch away from the point of displacement, in a direction axially of the roll. Hence if a plurality of webs are run through the machine at the same time, with lateral spacing between them as little as about one inch, the feed roll ribs or fins can readily accommodate themselves individually to each web, and each web will be fed just as though no other web were present in the machine, even through the other webs may have very different expansion characteristics.

This is well illustrated in Fig. 2, wherein three

webs are shown, and it is seen that the web at left has had very little expansion during its travel through the machine up to this point, so the fins of the feed roll are compressed to a relatively great extent under this lefthand web. The central web has had a somewhat greater expansion, so that the fins or ribs of the feed roll are not compressed so much under this web, while the righthand web has had a still greater expansion and compresses the ribs or fins to only a slight extent, if at all. But it is seen that the relatively great compression of the ribs under the lefthand web does not affect the position of the ribs under the center web.

This invention is especially useful in connection with a photographic processing machine for treating long webs of emulsion-coated photographic paper, the various compartments of the tanks containing developing, fixing, and washing baths, in known manner. However, the invention is not limited in its usefulness to photographic apparatus, and it may be used anywhere that webs of paper or other expansible sheet material are passed through liquid baths which cause the webs to expand longitudinally. For example, entirely outside of the photographic field, the invention may be employed in connection with passing paper strips through baths of coloring liquids, or applying successive liquid coatings of chemicals or other substances to paper strips.

Indeed, the invention is not limited to usefulness where the paper strip or other web expands upon being wetted; the same principles may be employed in driers, where the web contracts as it is being dried, so should be fed out of the machine at a slower rate than that at which the wet web is fed into the machine. In such a machine, the metering roll **52** would have a diameter substantially equal to the maximum effective diameter of the feeding rolls **40**, instead of being close to the minimum diameter thereof. Then the web, as it passed over the first few feeding rolls **40**, would not compress the ribs or fins on these rolls, but as drying of the web progressed, the contraction of the length of the web would increase the tension on succeeding feeding rolls and would bend the ribs or fins further and further over, reducing the feeding speed toward the exit end of the machine.

The use of feed rolls having automatically variable effective diameters, to take care of expansion of the web, has already been proposed; however, the prior constructions of such variable diameter feed rolls have been impractical and unsatisfactory for one reason or another, and the present invention provides a much more efficient and satisfactory variable diameter feed roll than those heretofore known.

It is seen from the foregoing disclosure that the abovementioned objects of the invention are admirably fulfilled. It is to be understood that the foregoing disclosure is given by way of illustrative example only, rather than by way of limitation, and that without departing from the invention, the details may be varied within the scope of the appended claims.

What is claimed is:

1. Web feeding apparatus embodying a series of spaced parallel supports over which a web may be run to form a multiplicity of continuing loops, certain of said supports comprising rolls the contact peripheries of which are composed of a plurality of relatively thin upstanding resilient ribs each arranged obliquely to a radial line passing through that rib and being laterally bendable to produce substantial variation in the effective working radius of the outer end of the rib, and means for driving the rolls in unison at the same rotary speed.

2. Web feeding apparatus embodying a series of spaced parallel supports over which a web may be run to form a multiplicity of continuing loops, certain of said supports comprising rolls, the contact peripheries of which are composed of a plurality of laterally bendable and resilient longitudinal ribs, of tapered cross section, thicker toward the inner ends and thinner toward the outer ends of the ribs the median planes of which ribs are substantially tangential to a circle struck from the axis of the roll, and means for driving the rolls in unison at the same rotary speed.

3. A flexible rubber propelling roll for web feeding apparatus the contact periphery of which is composed of a plurality of relatively thin upstanding laterally bendable and resilient longitudinal ribs adapted to respond to varying tensions in a web loop supported thereon, each rib being of tapered cross section thicker toward its inner end and thinner toward its outer end, the median planes of which ribs are approximately tangential to a circle struck from the axis of the roll, said ribs being readily bendable laterally to place the outer ends thereof substantially closer to or farther away from the center of said roller in response to variations in the tension of a web wrapped partially around said roll.

4. A web feeding roll having an effective diameter automatically variable to a substantial extent in accordance with relatively slight variations in the tension of a web passing over said roll, said roll comprising a shaft, a body of soft and resilient rubber-like composition surrounding said shaft, and a plurality of fins spaced circumferentially around said body, each fin extending longitudinally along said body and projecting from the body in an upstanding direction oblique to a radius extending from such fin to the center of said shaft and being relatively thin and flexible in a circumferential direction.

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