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CALENDER WITH DIFFERENT ROLL SIZES

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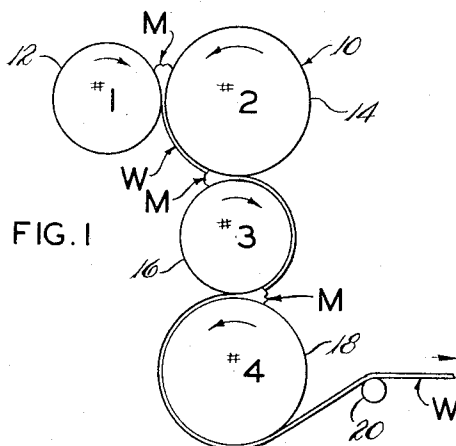


FIG. 1

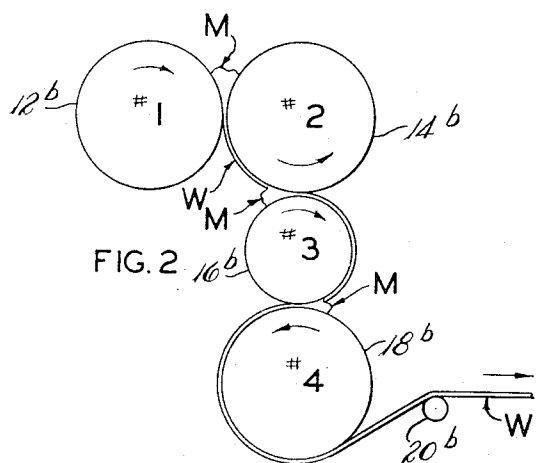


FIG. 2

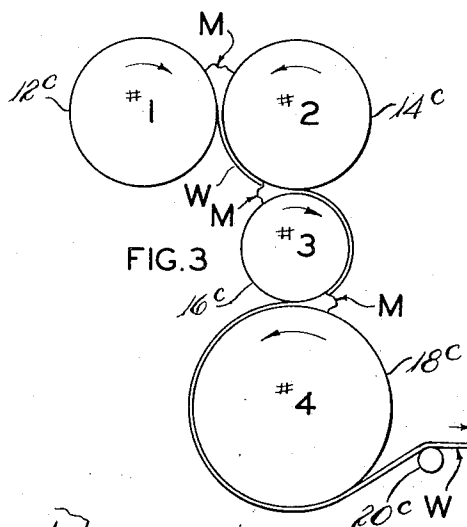


FIG. 3

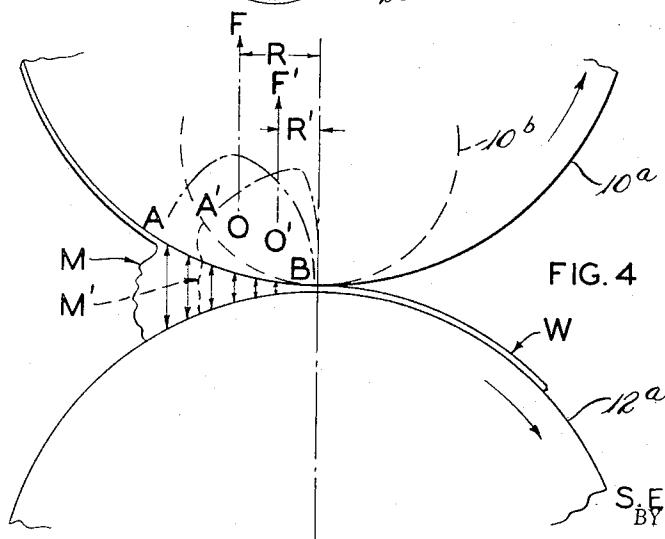


FIG. 4

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CALENDER WITH DIFFERENT ROLL SIZES
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ABSTRACT OF THE DISCLOSURE

An inverted L calender characterized by the middle roll of the calender having a reduced diameter in relation to the top and bottom rolls.

This invention relates to a calender for sheeting plastic, rubber, and the like into relatively thin continuously moving webs, or performing other calendaring operations, in which small diameter calender rolls are used in one or more positions of the calender in conjunction with larger diameter calender rolls.

Heretofore, calenders of the standard inverted L-shape have been composed of four calender rolls having substantially equal diameters. The calender rolls are large and heavy and are expensive to produce and install. The large diameter calender rolls, due to their large surface area, also tend to cause a frictional heat buildup when run for continuous periods and this can result in scorching the material to be worked. Usually some type of water or liquid cooling is employed internally of the rolls to prevent or control this frictional heat buildup but such a system is not always effective, and may be costly. The standard inverted L calender also requires a large power input to drive the calender rolls and this creates high production costs.

It is the general object of the present invention to avoid and overcome the stated and other difficulties of prior art practices by providing an inverted L-shaped or other calender in which small diameter calender rolls are used in conjunction with large diameter calender rolls. This permits the calender to be operated with reduced power input since the horsepower or mechanical energy needed to form the web between the calender rolls is lowered.

Another object of the present invention is to provide an inverted L-calender wherein the material worked is less subject to scorching because of frictional heat buildups.

Another important object of the invention is to provide a calender in which at least two of the bites provided by the calender rolls are formed by a large diameter calender roll and a small diameter calender roll with the small diameter calender roll being held against deflection from the bite by an adjacent large diameter calender roll. Reducing the deflection of the calender rolls produces the web at a more uniform gauge the full width of the web and reduces or eliminates corrective measures of gauge control, such as roll crown, roll bending, roll crossing, and the like.

The foregoing objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by providing the combination in a calender for sheeting plastic webs and the like of a plurality of calender rolls forming at least three bites, at least two of the bites being formed by a large diameter calender roll and a small diameter calender roll and wherein the small diameter calender roll is held against deflection from the two bites by a large diameter calender roll.

For a better understanding of the invention, reference should be had to the accompanying drawings wherein:

FIG. 1 is a diagrammatic side elevation of a typical in-

verted L calender in which smaller diameter rolls have incorporated in accordance with the invention;

FIG. 2 also is a view similar to FIG. 1 but of a modification of the invention.

FIG. 3 is a view similar to FIG. 1 but showing another embodiment of the invention.

FIG. 4 is an enlarged, fragmentary diagrammatic illustration comparing the resultant forces created by equal diameter calender rolls working on a web and a large and small diameter calender rolls working on a web.

In the drawings, and looking particularly at FIG. 1, the numeral 10 generally indicates an inverted L calender in which the four calender rolls are positioned in the usual relationship with each other. For purposes of clarification and convenience, the offset roll 12 is referred to as being in the number one position, top roll 14 is referred to as being in the number two position, middle roll 16 is referred to as being in the number three position, and bottom roll 18 is referred to as being in the number four position.

In the usual workings in an inverted L calender, the material M to be worked is fed between the #1 and #2 rolls which take a bite on the material to form web W (illustrated with an exaggerated thickness); the web W next passes between the #2 and #3 rolls with extra material M at the roll bite; the web W then passes between the #3 and #4 rolls with extra material M at the roll bite, and the web W then passing around the #4 roll and over a typical stripping roll 20 in the direction of the arrow. Note that roll #3 is supported against deflection by both rolls #2 and #4 whereby lateral gauge of the web W is held substantially uniform.

Referring to FIG. 4, as the material M is operated upon at the bite formed by the equal diameter calender rollers 10a and 12a to produce web W, the material M creates forces acting in upward and downward directions which tends to push the rollers 10a and 12a apart, and which forces resist rotation of the rolls in the direction of the arrows. The resultant force can be graphed diagrammatically and since it acts on both roller 12a and 10a, the force has only been shown in detail on roller 10a. This force graph is represented by line AB with the center point of the force F acting upwardly from point O. This force F or the component thereof acting towards the roll axis tends to push the calender roll 10a away from calender roll 12a and tends to bend roll 10a. In addition, force F acts on moment radius R to oppose the turning of roll 10a in the direction of the arrow. The greater this resistive force ($F \times R$), the higher the frictional heat buildup of the calender.

When a smaller diameter calender roll 10b is used with calender roll 12a to take a bite on the material M (the smaller diameter calender roll 10b indicated by the dotted lines in FIG. 4), another force graph can be plotted, this one being indicated by the line A'B' with the center of the resultant force being located at O'. This upwardly acting resultant force, indicated by F', is less than the force F, and works on the shorter radius R'. Accordingly, the power required to rotate roll 10b and to overcome $F' \times R'$ is definitely less than the power to rotate roll 10a and to overcome $F \times R$. The smaller diameter calender roll 10b permits the calender to be run with less frictional heat buildup and a smaller horsepower input. It is important to note that although the smaller diameter calender roll enables the calender to be run with less horsepower input and thus greater efficiency, the quantity and quality of the web produced is not lowered, and usually is improved.

It has been stated above that roll #3 in FIG. 1 is supported by roll #2 and roll #4. Further, it will be recognized that there are less roll bending pressures on rolls #2 and #4 than if roll #3 were of the same size as rolls #2 and #4.

In the form of the invention of FIG. 2, the calender roll 16b is of reduced diameter but the calender roll 12b is of equal diameter with the remaining two calender rolls 14b and 18b.

FIG. 3 illustrates that the calender roll 18c occupying the #4 position, can be of an extra large diameter greater than calender rolls 12c and 14c. This positioning of the calender rolls tends to reduce the deflection of calender roll 16c in the #3 position when the web passes between the calender rolls in the #2 and #3 positions, and the calender rolls in the #3 and #4 positions.

The forms of the invention as shown in FIGS. 2 and 3 operate with at least certain of the advantages of the apparatus of FIG. 1.

Throughout the specification and claims the terms "large," "extra large," and "small" are intended to define and cover combinations wherein the small diameter roll is between about 50% and about 75%, and usually about 66% of the diameter of the large roll. The large diameter roll is between about 60% and about 90% of the extra large diameter roll, and usually about 75%. In a typical calender designed in accord with the invention, the diameter of the large roll was 32" and the diameter of the small roll was 20".

While a certain representative embodiment and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. An inverted L-shaped calender comprising four calender rolls forming three bites, wherein the #3 position roll has a diameter between one-half and three-quarters the size of the #1 and #2 position rolls and the #4 position roll has a diameter between one-third and one-half times greater than the #1 and #2 position rolls and wherein the small di-

ameter roll in the #3 position is held against deflection from the two bites by the adjacent large diameter rolls.

2. The combination in an inverted L calender for sheeting plastic, rubber and the like into a web of a plurality of calender rolls forming at least three bites, at least two of the bites being formed by a relatively large diameter calender roll and a relatively small diameter #3 calender roll and wherein the small diameter #3 calender roll is held against deflection from the two bites by a large diameter calender roll, the #3 position roll having a diameter of between about one-half and three-quarters the diameter of the #2 position roll, the calender having less frictional heat build-up than calenders with equal size rolls therein comparable to said large diameter roll whereby the roll speed in said L calender can be increased above that of the comparable calender without exceeding the critical temperature of the material being processed.

3. An inverted L calender for forming webs characterized by the middle roll having a reduced diameter in relation to the top roll and the bottom roll wherein the smaller diameter middle roll is held against deflection by the larger diameter bottom roll from the bite formed with the top roll and, conversely, is held against deflection by the large diameter top roll from the bite formed with the bottom roll, and wherein the offset roll has a reduced diameter in relation to the top roll.

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