Aug. 6, 1957 J. S. MEARES 2,801,439

CALENDER ADJUNCT

Filed Sept. 13, 1954

Fig. 2

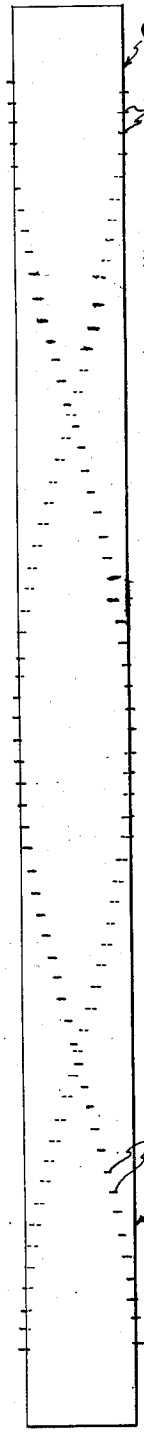

Fig. 1

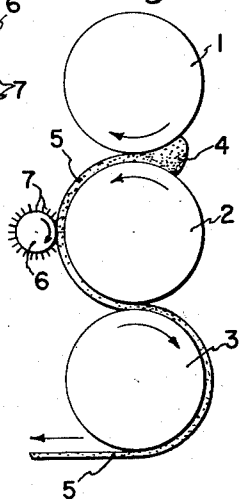

Fig. 3

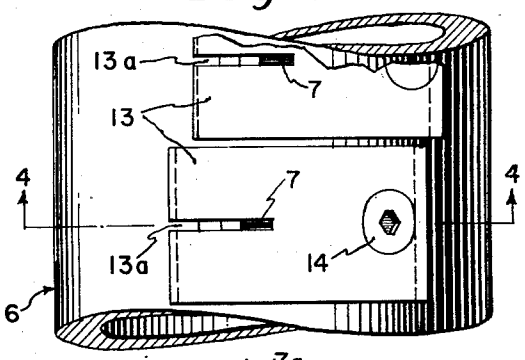

Fig. 4

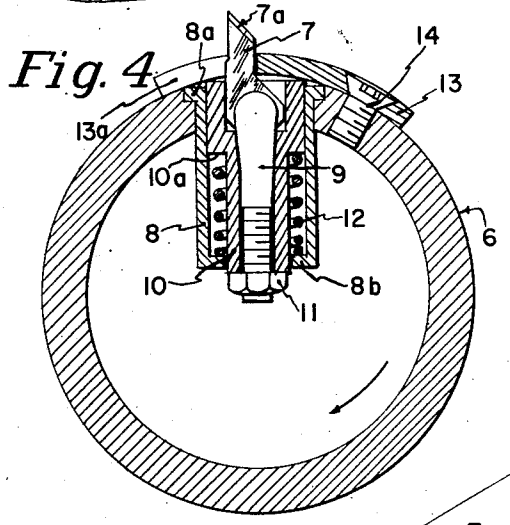

Fig. 5

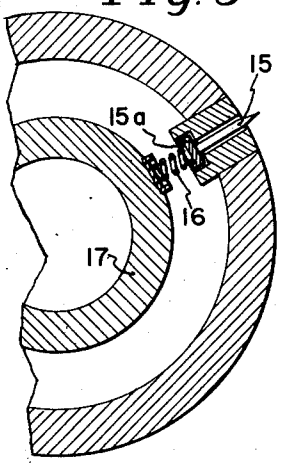

Fig. 6

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CALENDER ADJUNCT

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3 Claims. (Cl. 18—2)

This invention relates to a calender adjunct and more particularly to the combination of a piercing roll and calender rolls adapted for cutting or puncturing a calendered film during its processing.

In the forming or rubber, synthetic rubber and resinous films, sheets and coated fabrics by the well-known calender process air and other gases are entrapped in the plastic mass and between the film or coating and the surface of the calender roll which result in the formation of bubbles and blister streaks in the finished film. In a three or four roll calender the blisters and streaks are usually formed while the film or coating is on the second or third rolls, respectively.

A device proposed to elminiate the blisters and air streaks encountered during the formation of films by the calender process is illustrated on page 194 of "The Neoprenes," by Neil L. Catton, published in 1953 by the Rubber Chemicals Division of E. I. du Pont de Nemours & Company. This involves threading the calendered film around a roll (referred to as an air bar) positioned near but not in contact with the penultimate calender roll. Such a device is not entirely satisfactory since a slight lateral variation in thickness results in damage of the calendered film due to the formation of wrinkles. Another disadvantage of the use of the air bar is the limitation imposed by tacky compounds which tend to adhere to the calender rolls, thus making threadup around the air bar difficult.

An object of this invention is to provide an ancillary piercing roll adapted for use with calenders which eliminates the formation of bubbles and blister streaks in calendered films and coatings calendered on flexible substrates. A further object of this invention is to provide a piercing roll which provides uniform pressure between the ends of the piercing elements and the film mounted on the calender roll. A still further object is to provide a piercing roll in which the pressure applied by the piercing elements is self-adjusting.

These and other important objects are accomplished by providing a roll having a plurality of spring loaded piercing elements adapted for use in conjunction with a calender.

In order to more clearly describe this invention, reference is made to the accompanying drawing which illustrates the embodiments of the apparatus suitable for carrying out the invention, in which:

Figure 1 is a diagrammatic end view of a three roll calender showing the piercing roll, with but a limited number of piercing elements illustrated, mounted to operate on the middle roll.

Figure 2 is a plan view of the surface of the piercing roll showing two rows of piercing elements, each arranged spirally around the roll.

Figure 3 is a fragmentary view of the surface of the piercing roll showing a plan view of one complete piercing element assembly and a portion of another.

Figure 4 is a detail sectional view of line 4—4 in Figure 3.

Figure 5 is a detail sectional view of the piercing roll showing a modification of the preferred embodiment of the invention.

Figure 6 is an exploded view of a piercing element assembly.

Referring to Figure 1 of the drawing, the apparatus of this invention comprises heated calender rolls **1**, **2** and **3**, with piercing roll **6** operating on roll **2**. A compounded plastic material **4** is formed into a uniform sheet on roll **2** which is illustrated as **5**. The plastic compound **4** is previously prepared by milling a plastic film-forming material such as, e. g., rubber, synthetic rubbers, synthetic resins, cellulose derivatives and the like, with other compounding ingredients, then transferring the mixed compound **4** to the nip of rolls **1** and **2** as indicated in Figure 1. The mixing and milling cause considerable air and other gases to be occluded in the plastic mass **4**. Hereinafter the term "air" is used to denote air and other gaseous materials. The plastic mass **4** is also subject to additional working in the nip of rolls **1** and **2** where additional air may also be occluded in the plastic compound **4**. As the calender rolls **1**, **2** and **3** revolve under pressure, in the directions indicated by the arrows, the plastic mass **4** is squeezed between rolls **1** and **2** to form a uniform film **5** on roll **2**. Piercing roll **6** is juxtaposed roll **2** with the axis of each being in substantially the same horizontal plane. Piercing roll **6** is rotated by the frictional contact with film **5** on roll **6**. Roll **6** may also be driven if desired. The piercing elements **7** on roll **6** pierce the film **5** thus allowing the occluded air in film **5** to escape. As the film **5** passes through the nip of rolls **2** and **3** the openings or punctures in film **5** are closed due to the pressure applied to the film **5**. After the film **5** leaves the calender roll **3** it is passed around cooling rolls and windup (not shown in the drawing).

Figure 2 shows the arrangement of the piercing elements on roll **6** which is 66" long. There are two rows of the piercing elements **7**, with 60 piercing elements **7** in one row and 59 in the other. Each row of piercing elements **7** is arranged in a counter-clockwise spiral and circumscribes the roll **6**. The two rows of piercing elements **7** are located 180° from each other. Each row of piercing elements **7** spiral through 360° of the periphery of roll **6** and are uniformly spaced within a 60" length of roll **6**. Each piercing element **7** is located 6° around the periphery of roll **6** from the adjacent piercing element **7** and is advanced one inch parallel with the axis. Roll **6** is a hollow shell with countersunk openings to receive the piercing element assemblies as illustrated in Figure 4. The individual piercing element assemblies are made up of a housing **8** with an annular collar or flange **8***a* which rests against the countersunk rim of the openings in the roll **6**. The piercing element **7**, as illustrated in Figure 4, is a knife blade with an angular (about 45°) cutting edge **7***a*, to provide a slit in the film **5**. The shank of knife **7** fits into a slit **9***a* in the end of a conical shaped bolt **9**. The end of bolt **9** opposite the slotted end is threaded and passes through an opening in the bottom of cartridge **10** and housing **8**. Bolt **9** being conical shaped, as nut **11** is tightened the enlarged end of bolt **9** is drawn downward into cartridge **10** and the slit squeezes shut on the shank of blade **7**, thus firmly engaging the shank of blade **7**. Cartridge **10** has an annular flange **10***a* which rests on a spring **12**. The spring **12** is supported by the bottom of housing **8** at **8***b*. Thus it will be seen that blade **7**, bolt **9** and cartridge **10** move back and forth in housing **8** as pressure is applied and released against the cutting edge of blade **7**. The housing **8** is held in position with a retaining plate **13** which is fastened to the outer surface of roll

6 by means of bolt 14. The retaining plate 13 has a slit opening 13*a* through which the knife 7 protrudes.

Figure 3 illustrates the manner in which the individual piercing element assemblies are arranged in relation to each other, i. e., each being advanced one inch parallel to the axis of roll 6 and rotated 6°, thus there are 60 piercing elements 7 in one row and 59 in the other, both of which circumscribe roll 6 spirally, through a 60" horizontal length of the roll 6. The first piercing element in one row is 3 inches from the end and the first piercing element in the other row is 3½ inches from the end, thus the piercing elements in each row are not directly opposite each other.

In operation, as the calender rolls 1, 2 and 3 are rotated by a motor drive (not shown), the piercing roll 6 is rotated in the direction indicated by the arrow by contact with roll 2 covered by film 5. An important feature of this invention is that the depressible piercing elements 7 adjust themselves as the pressure varies in order that excessive pressure is not applied by the piercing elements 7 pressing against the surface of the calender roll 2, thus the marring of the face of calender roll 2 is minimized or eliminated entirely. There is also less chance for the piercing elements to be broken and pass through the nip which would also mar the surface of calender roll 3. This feature will be readily recognized as an important contribution to those skilled in the art in view of the high cost of re-surfacing calender rolls.

A modification of the inventon is illustrated by Figure 5 wherein a pin 15 is employed as the piercing element. In this modification the piercing elements are arranged in the same manner as described above. The base 15*a* of pin 15 is supported by a spring 16 which in turn is supported on inner roll 17.

It will be readily understood that various modifications may be made without departing from the scope of the invention. For example, there may be employed any number of piercing elements on the piercing roll and they may be arranged in any pattern such as straight rows across the width of the roll or around the roll, or spiral around the roll in a clockwise direction.

As indicated above the piercing element may comprise either a pointed pin-like element or blade or knife with an angular cutting edge. An advantage of the preferred embodiment of the invention, in which the piercing element is a blade or knife with an angular cutting edge, is that the tangential force acting upon the cutting edge is applied in such a manner that there is a radial component of force which tends to depress the blade with a minimum of force as soon as there is contact of the cutting edge of the blade and the film attached to the calender roll. Thus there is less tendency to mar the face of the calender roll by the cutting edge of the blade.

While there are above disclosed but a limited number of embodiments of the structure, process and product of the invention herein presented, it is possible to produce still other embodiments without departing from the inventive concept herein disclosed, and it is desired therefore that only such limitations be imposed on the appended claims as are stated therein, or required by the prior art.

What is claimed is:

1. The combination of a plurality of calender rolls comprising at least three calender rolls and an ancillary piercing roll juxtaposed the face of the penultimate calender roll forward of the nip formed by said penultimate roll and the final roll, the axis of said ancillary roll being parallel with the axis of said penultimate calender roll and having a plurality of spring loaded knives protruding from the surface thereof, the cutting edges of said knives being in planes substantially perpendicular to the axis of said ancillary roll and being at obtuse angles with the leading edge of the knife blade.

2. The piercing roll of claim 1 in which there are two rows of piercing elements which spirally circumscribe the roll.

3. The piercing roll of claim 1 in which the rows of piercing elements spirally circumscribe the roll in a counterclockwise direction and each row of piercing elements is positioned 180° from the other.

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