June 11, 1957 B. B. BLACKFORD 2,795,521

METHOD OF CALENDERING A PLASTIC MASS

Filed June 5, 1953

Fig. 1.

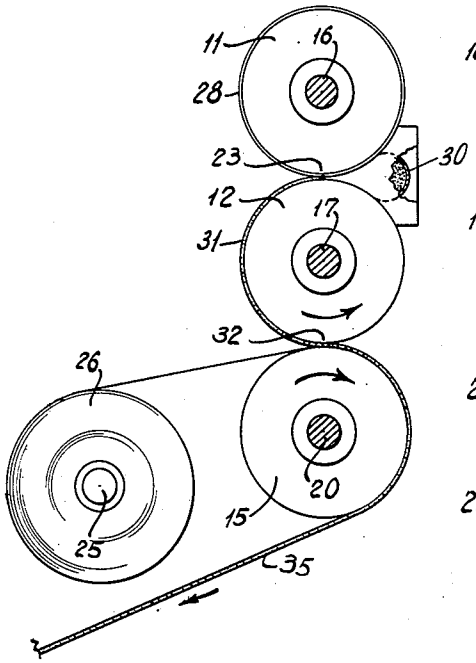


Fig. 2.

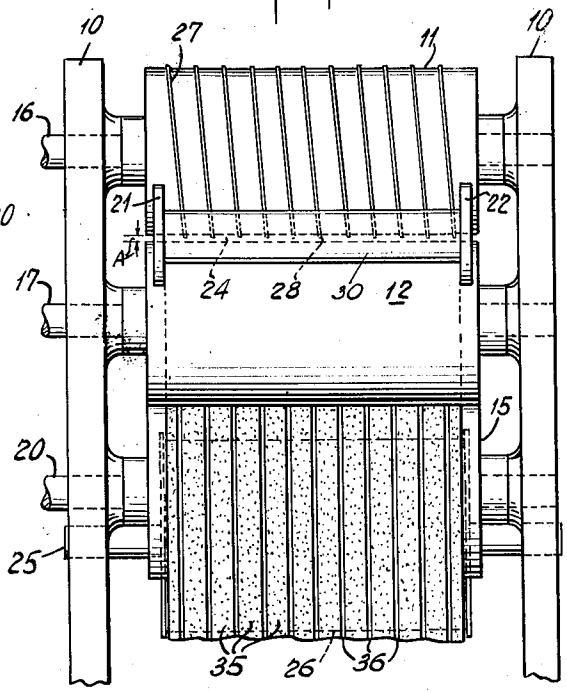
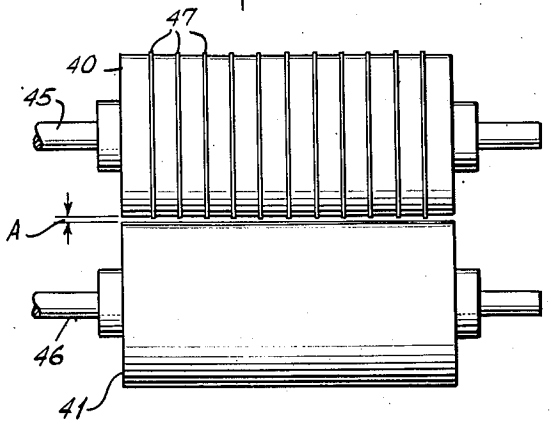


Fig. 3.



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METHOD OF CALENDERING A PLASTIC MASS

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3 Claims. (Cl. 154—102)

The invention is directed to spreading of adhesive on webs in parallel strip zones leaving parallel uncoated zones on the web between the coated zones. Particular embodiments of the invention are directed to preparation of such zone coated webs for use as backing material for surgical dressings, and in particular, adhesive bandages.

Backing sheets utilized in ordinary adhesive bandages are coated with an adhesive mass which covers the entire sheet. In many instances merely to assure firm anchorage of the bandage to the patient it is not necessary to coat the entire surface of the backing with adhesive, and therefore economy without sacrifice in quality would be realized by coating the backing material with adhesive in zones or strips. In other cases, to produce proper venting of the adhesive bandage it is necessary to perforate the backing in the region of the dressing pad, whereas if regions of the backing were left uncoated with adhesive the natural permeability of the uncoated backing sheet would afford sufficient venting without the necessity and additional expense of perforation. Hence, one object of the invention is to produce a sheet zone-coated with adhesive which may be used in manufacture of adhesive bandages with particular advantage from the standpoint of economy and improved venting characteristics.

Prior art zone coating procedures have been carried out on the order of Gilchrist U. S. P. 2,086,126 which requires the use of raised portions of metal on the roll itself which pick up adhesive from a kiss roll and deposit this adhesive from the raised portion directly onto the web. There are many disadvantages to this type operation among which are the necessity of specialized, high-cost equipment, and the tendency of the raised portions on the roll to wear excessively due to direct contact with the kiss roll.

One object of the present invention is to develop a procedure and machinery for zone coating of adhesive on moving webs which is simple and inexpensive and does not involve the use of specialized high-cost equipment.

According to the present invention, coated and uncoated longitudinal zones are calendered on a continuous web of material by feeding adhesive mass between a pair of adjacent rolls, one of the rolls having raised portions on its periphery and adjacent the other roll, the raised portions being spaced axially from each other. The raised portions on the one roll do not, however, touch the other roll. Said other roll rotates, and the temperature of the rolls is controlled to control in turn the plasticity of the adhesive so that said raised portions, as the adhesive is drawn as sheet or film between the rolls, cause the adhesive film to divide into separate, longitudinal sections which are subsequently deposited on a continuous sheet of material to form longitudinal coated and uncoated zones thereon. The raised portions on the first roll correspond and are substantially coextensive with the uncoated zones of material and, conversely, the unraised portions correspond and are substantially coextensive with the coated zones. It is a particularly notable feature of the invention that division of the adhesive film between the rolls and resulting uncoated zones on the fabric are produced without having the surfaces of the two rolls forced together or in contact. This is accomplished as indicated utilizing a suitable adhesive so that at the temperature of the operation the plasticity of the adhesive is sufficiently low so that the adhesive film divides spontaneously when it passes between the raised portions of the one roll and the second roll. The invention also includes the apparatus for carrying out the operation described.

In addition to accomplishing the objects set forth above, the advantages of the invention include provision of method and means for manufacture of a product which may be made more economically since it contains less adhesive than the usual calendered product, and also has the desirable property of permitting some passage of water vapor so that in use as a backing for adhesive bandages it is not necessary to perforate the backing to provide for breathing of the bandage.

The invention may be conveniently understood by reference to the attached drawing in which the same reference number refers to corresponding parts of the various figures.

Fig. 1 is a side elevation view of a three roll calender constructed according to the invention.

Fig. 2 is a front elevation of the apparatus in Fig. 1.

Fig. 3 illustrates the top two rolls of Figs. 1 and 2 constructed according to a modified form of the invention.

Reference number **10** designates a supporting frame for a three roll calender having a top roll **11**, a middle roll **12** and a bottom roll **15**, respectively. The top roll is supported on axle **16**, the middle roll on axle **17** and the bottom roll on axle **20**, each axle being supported in frame **10**. Ear blocks **21** and **22** disposed at opposite ends of the top and middle rolls serve to guide adhesive into the nip between these two rolls. Feed roll **25** contains a wind-up of sheet material which may be fabric, non-woven or woven, or may be synthetic material such as regenerated cellulose.

Top roll **11** is provided on its periphery with a spiral winding of material **27** such as a sturdy thread of textile fibers anchored at each end to roll **10** or to frame **10** at points not shown. Band **27** may be narrow or wide, as will appear hereinafter, depending upon whether it is desired to have narrow or wide areas of uncoated material in the final product. It will be noted that the rolls **11** and **12** are not in contact, but that there is a finite space designated as A in Figs. 1 and 2 separating these two rolls at the nip **23**. A notable feature of this invention is that the band of material **27** does not fill in all of the space A but leaves a small but finite clearance between the outermost limits of band **27** and the topmost surface of roll **12**. The importance of this feature of the invention apparatus will appear hereinafter.

The apparatus is operated as follows. An adhesive mass having suitable plasticity and other properties given below is placed in a bank between ear blocks **21** and **22** and the nip between rolls **11** and **12**. Rolls **12** and **15** are rotated in the direction indicated in Fig. 1, while roll **11** remains stationary. Alternatively, roll **11** may rotate slowly in which case band **27** may suitably be secured to roll **11** itself rather than to frame **10**. The adhesive from bank **30** tends to be drawn into and out of the nip between rolls **11** and **12** as a thin sheet **31** having a smooth surface and uniform thickness depending upon the clearance A between the rolls. The temperature and speed of the rolls are controlled as they are in normal calender operations. Near the point where rolls **11** and **12** are closest to contact, the film of adhesive **31** from bank **30** is divided or split by the raised portion **27** of the band into individual films **31** which travel around the left side of roll **12** as seen in Fig. 1 and into

the nip 32 between rolls 12 and 15. At this point the individual sheets of adhesive 31 on the surface of roll 12 meet and contact the upper surface of fabric 26. The adhesive adheres to the surface of fabric 26 and leaves the periphery of roll 12. The individual areas of adhesive coated on fabric 26 are shown at 35 on Fig. 2 with parallel uncoated areas of adhesive therebetween at 36. It will be noted that the uncoated areas 36 correspond and are substantially co-extensive in width with the band material 27 in the nip between rolls 11 and 12.

To provide the splitting and dividing action by ridges 28 on roll 11 it is important that, if roll 11 is not stationary, it should move at a rate which is slower than the rate of movement of the film 31 emerging from the nip 23. Movement of roll 11 may be clockwise or counterclockwise. It is important only that any clockwise directional movement should be slower than that corresponding with a peripheral speed equal to the speed of movement of film 31.

In the modified embodiment of the invention illustrated in Fig. 3 top roll 40 and middle roll 41 are shown with space A therebetween. These rolls are supported on axles 45 and 46 mounted in a frame not shown similar to frame 10 in Fig. 2. Instead of band of material 27 wound spirally around the top roll, roll 40 is provided with individual bands 47 secured to roll 40 by means not shown. These individual bands 47 in the nip between rolls 40 and 41 perform a function corresponding to those portions of band 27 in the nip 23 between rolls 11 and 12. The width, spacing, height and clearance between the rolls is controlled in the Fig. 3 embodiment in the same way and for the same purposes as in the case of the Fig. 2 embodiment described above.

The material of which the band is made is a factor of considerable importance in the present invention. It is preferably made of a material softer than that of the surface of roll 12. This affords the advantage that in the case of inadvertent contact between band 27 and roll 12 there will be no or little wear between the parts in contact, and in particular, no wear of the surface of roll 12, thereby necessitating rebuilding of the equipment, or at the very least, expensive maintenance. The bands may be made suitably of either fabric or metal or other material. The height of the band is also important. As indicated above, it does not come in contact with the outer surface of roll 12. However, it should be sufficiently high to cause splitting or dividing of the film of adhesive from bank 30 in the region of nip 23. With this object in view the height of band 27 should be at least about one half the dimension A, i. e. one half the distance between rolls 11 and 12 at nip 23. It is seen, therefore, that the depth of groove 24 which is equal to the height of ridges 28 is preferably at least about as great as the finite distance between the radial extremity of ridges 28 and the adjacent surface of roll 12.

The plasticity of the adhesive mass in bank 30 will be influenced by the temperature of rolls 11 and 12, the degree of working on the rolls controlled in turn by the roll speed, and the internal friction brought about by this working. The tendency of the adhesive film from bank 30 to divide into separate longitudinal areas as described above is influenced to a degree by this plasticity. Accordingly, in the present invention the nature of the mass is such as to afford under operating conditions a mass plasticity sufficiently high to produce the desired dividing of the film.

It is not always predictable from the mass plasticity at room temperature or at any given temperature what the plasticity of the mass will be as it is being worked in the bank on the calender rolls. However, suitable masses for zone coating according to the invention may be made by compounding approximately equal parts of elastomer, tackifier and extender. The elastomer may be natural rubber, butadiene-styrene copolymer, reclaimed rubber, or polyisobutylene elastomer. Mixtures of these various elastomers may be employed. Any of various tackifiers known in the art may be satisfactorily utilized. "Extenders," as the term is used here, includes also fillers and pigments. Zinc oxide, titanium dioxide, and starch are examples of ingredients falling in this classification. In addition to the above three groups of ingredients the adhesive may also be plasticized with any of several plasticizers known in the art.

According to preferred embodiments of the invention, the masses are so compounded that their plasticities measured under standard conditions of test are within a certain preferred range. Plasticity is measured on a cylindrical pellet of adhesive mass 16 mm. in diameter and weighing 2.00 grams. By placing the pellet on a parallel plate plastometer of the type manufactured, for example, by the Scott Instrument Company, and maintaining the pellet and surroundings at 100° F. and under a 5000 gram load for 14 minutes, the height in millimeters of the pellet after this time is taken as a measurement of plasticity. The preferred plasticity range is approximately 1.5 to 2.5 mm. However, lower or higher plasticities may be used depending upon the behavior of the adhesive when it is subjected to the conditions prevailing in the bank between the calender rolls.

One satisfactory adhesive mass is composed of polyisobutylene according to Wing U. S. P. 2,484,060, preferably with an average molecular weight (Staudinger) of about 100,000 compounded with effective amounts of tackifier, plasticizer, pigment, etc. as disclosed in the patent. For purposes of the present invention, it is milled for time to impart plasticity of 1.5 to 2.5 mm.

Another suitable mass is based on natural pale crepe rubber (33%) and contains dehydrogenated rosin acid M. P. 70–72° C., tackifier (25%), lanolin (7%) as plasticizer, TiO_2 (15%) and ZnO (15%) as pigment, and starch (5%) as filler, and is milled for time to provide a plasticity of from 1.5 to 2.5 mm. Blends of the synthetic and natural rubbers may be utilized.

The following is an example of procedure for manufacture of a zone-coated fabric particularly suitable for use as a backing for adhesive bandages. A web of woven material having a count of 80 x 80 per inch and a weight of 3 ounces per square yard is unrolled from roll 25 and fed into the nip between rolls 12 and 15. An adhesive mass having the composition described in the next preceding paragraph and a plasticity of 1.70 mm. is preheated to 240° F. and charged to bank 30 from which it is fed into nip 23 between steel rolls 11 and 12. Roll 11 is operated at 250° F. and roll 12 at 170° F. thereby to maintain bank 30 at about 240° F. The spacing between rolls 11 and 12 is 0.004 inch. Roll 11 is wound on its outside periphery with a ribbon of copper wire having a square cross section 0.003 inch thick and 0.020 inch wide. The winding is arranged in a spiral fashion and secured at the two ends to stationary parts of frame 10. Said copper ribbon forms ridges 28. With the winding in place the distance between ridges 28 is ½ inch. The height of ridges 28 above the surface of roll 11 is 0.003 inch and the width of each ridge is 0.020 inch. Roll 11 is stationary and roll 12 rotates at a peripheral speed of 90 feet per minute. The mass divides into separate individual sheets 35 with intervening parallel zones of no adhesive. The product as it is withdrawn from roll 15 contains parallel coated zones ½ inch wide and intervening uncoated zones approximately 1/16 inch wide. The adhesive strip moves with rotation of roll 12 from nip 23 to the bottom of roll 12 where contact is made with the upper surface of fabric 26. The fabric picks up the adhesive strips which become embedded in fabric 26.

Various modifications and equivalents which will now be apparent to those skilled in the art, although not specifically recited above, are intended to be included within the scope of the invention. It is intended that

the invention be limited, not by the above disclosure, but only by the appended claims as fairly interpreted in view of the disclosures of the prior art.

The claims are:

1. A method of calendering a pressure-sensitive adhesive mass having a plasticity at 100° F. in the range of about 1.5 to 2.5 mm. and comprising a tackifier and an elastomer, the latter being selected from the group consisting of natural rubber, reclaimed rubber, butadiene-styrene copolymer and polyisobutylene, which method comprises forming a relatively wide film thereof at a temperature of about 240° F., said film being of a thickness of about 0.004 inch, and pressing parallel grooves therein about 0.003 inch deep and about 0.02 inch wide, said grooves being about 0.5 inch apart, while moving said film in the direction of said grooves, whereby separate parallel films about 0.004 inch thick and about 0.5 inch wide are obtained.

2. A method of claim 1 wherein the parallel films are deposited upon a continuous sheet of material forming longitudinal coated and uncoated zones thereon, said uncoated zones being about 1/16 inch wide.

3. A method of claim 2 wherein the plasticity is about 1.7 mm.

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