Feb. 18, 1969 E. H. GRUPE ETAL 3,428,517

PACKING MATERIAL FOR LETTERPRESS IMPRESSION CYLINDERS

Filed Nov. 27, 1962 Sheet / of 2

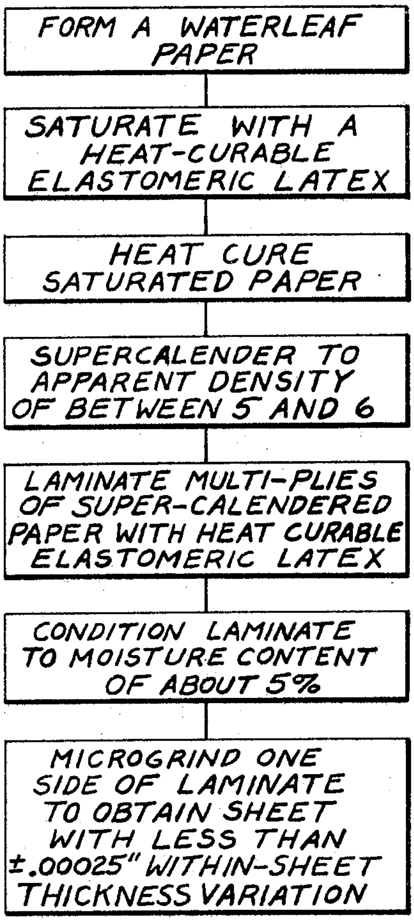

FIG. 1

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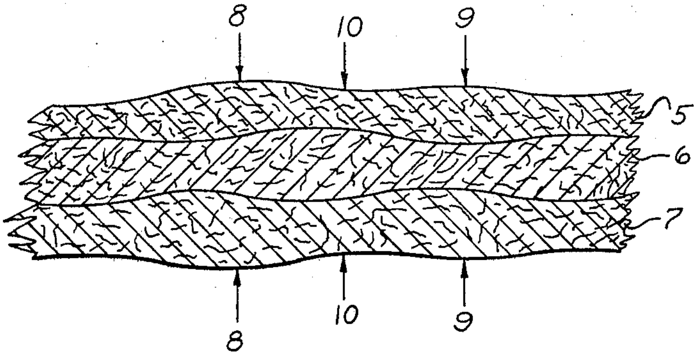

FIG. 2

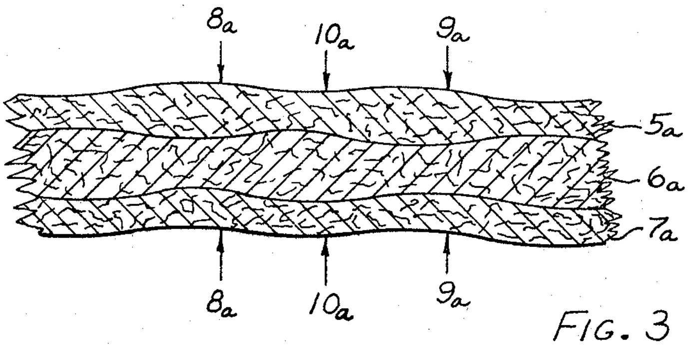

FIG. 3

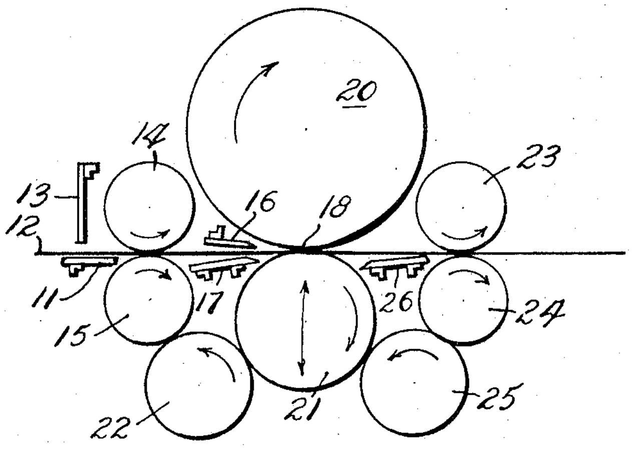

FIG. 4

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PACKING MATERIAL FOR LETTERPRESS IMPRESSION CYLINDERS

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Int. Cl. B32b *27/30, 25/12*

ABSTRACT OF THE DISCLOSURE

An improved packing material for letterpress impression materials consisting of a unitary laminate of elastomer impregnated webs of alpha-cellulose fibers. The laminate has a uniform apparent density of about 5 to 6 obtained by heat-curing the elastomer impregnant in the component webs and subsequently supercalendering the cured webs to the desired density before laminating. After laminating, one side of the laminate is microground to a depth less than the thickness of one component web. The finished laminate has a smooth suede-like finish on the microground side. The microgrinding removes local areas of disuniformity in thickness and density so that the maximum within-sheet thickness variation is less than ±.0075''.

This invention relates to an improved material for packing the impression cylinder of letterpress printing presses. It relates further to a method for manufacturing packing material with improved uniformity in thickness and density.

In letterpress printing, the printing member commonly is a rotating cylinder on which raised type or other printing means are mounted. The web to be printed passes through a printing couple formed by the rotating printing member and a coacting impression cylinder. The printing member and impression cylinder are held in spaced relationship by cooperating peripheral bearer strips. The bearer strips of the impression cylinder form the lateral boundaries for a peripheral undercut area of the cylinder. The press is made ready for printing by filling in this undercut area to a level slightly above the bearer strip surface with layers of sheet stock which include a resilient packing material. Filling in the undercut area to the desired level is called "makeready" and provides the impression cylinder with a suitable yielding surface to hold the web firmly against the inked portion of the printing member and effect ink transfer from plate to web.

Impression cylinders on presses manufactured 50 years ago were commonly undercut about 0.060'' to 0.070'' for packing. Today, very few presses used in general shop work, as well as magazine printing, have bearer cuts more than 0.040'', and the newer presses have reduced the undercut still more to about 0.035''. Thus, thinner packings place a greater responsibility on the plate maker to produce higher quality printing plates of uniform levelness, and at the same time additional responsibility is placed on the pressman to obtain greater precision in packing the impression cylinder and underlaying the plates during makeready. As a result, the printers are requiring manufacturers of packing materials to produce packing materials with more uniform thickness and density.

In addition to uniform thickness and density, the packing material must not mat down or emboss during use. It must have the quality of quick recovery from the high pressures imposed by the printing press in order that each successive impression on the packing will provide substantially the same results as its predecessor, especially when successive colors are used in multicolor printing. For example, on a common impression cylinder used in multicolor work, the length of time between successive color application on a high speed press may be as little as 1/30 of a second. Thus, the ideal packing material should have almost instantaneous recovery, or at least provide a uniform pressure for each rapidly succeeding impression.

It is therefore an object of this invention to provide improved letterpress impression cylinder packing material having suitable recovery properties as well as more uniformity in thickness and density than it has hitherto been possible to obtain. It is an additional object to provide a method for manufacturing such improved packing material.

Additional objects and advantages of the invention will become apparent from the following detailed description of certain preferred embodiments together with the accompanying drawings, in which:

FIG. 1 is a flow diagram showing the sequence of steps involved in producing the preferred embodiment of the packing material of this invention.

FIG. 2 is a greatly enlarged cross section of one embodiment of the packing material of this invention in an intermediate stage, i.e., after supercalendering and lamination.

FIG. 3 shows the same cross sectional area of the packing material as in FIG. 2, after microgrinding one side.

FIG. 4 is a simple cross sectional view of a standard microgrinding apparatus employed in grinding the packing material.

As noted above, more and more printers are requiring that the materials employed to build up impression cylinder packing have better uniformity in thickness and density in order that higher quality printing may be obtained. Experience has shown that the sheets making up the resilient layer in impression cylinder packings are the elements which give printers the most trouble in the way of thickness and density variation. This invention is directed to providing a resilient packing material in which the maximum thickness variation within the resilient packing material in the standard thicknesses required for packing is reduced to less than ±0.00075'', and preferably to less than ±0.00025'', without destroying other desirable characteristics in such sheets.

Before describing the improved packing material of this invention, a brief description of the arrangement of packings on the undercut portion of impression cylinders appears to be in order.

In the packing, or makeready, of impression cylinders several types of sheet material are ordinarily used. The surface, or top sheet, is commonly called a tympan. The tympan is placed over an underlayment, the major thickness of which comprises a less dense resilient material designed to yield firmly under the pressures imposed by the printing plates. The impression cylinder packing may be built-up further to the desired thickness by positioning additional hard sheets of regular tympan, or manila, underneath the thicker resilient material in direct contact with the impression cylinder.

Tympan is normally a tough, even-calipered, hard manila-colored paper usually treated with oil. Another type of tympan is made with a hard coating of thousands of microscopic ceramic beads. Tympan ranges in thickness from about 0.003'' to about 0.012''. The most common thicknesses employed are in the range of 0.006'' to 0.010''.

The tympan sheet is severely calendered during manufacture to harden the sheet and to reduce within-sheet caliper or thickness variations. However, even with hard calendering, actual caliper variations are in the neighborhood of 10% of the total thickness, while density variations are magnified rather than improved. Inherent limitations in the paper manufacturing process produce thick and thin areas in the formed sheet and militate against reducing thickness or density variations below the aforesaid 10%. Similar limitations apply to the other paper sheets used in building up the thickness of the packing to the desired level. Efforts to reduce the thickness and density variations of any of the elements making up the packing have been only partially successful up to now.

Most of the effort spent in attempting to solve this problem has been devoted to work on the resilient element in the packing combination since this element comprises the major thickness of the packing, i.e., from .020" to .030", hence usually has proportionately greater within-sheet thickness variation, and is the major contributor to variations in packing thickness.

One improvement in this direction has been the recent introduction into the market of a resilient packing material comprising elastomer impregnated cellulose fiber sheets laminated together and heat-cured in a high pressure press. Such material and its method of manufacture is described in U.S. Patent 3,053,718, Hechtman et al., issued Sept. 11, 1962. By laminating several sheets together the thick and thin spots are more or less averaged out, and by applying high pressure and simultaneously curing the laminate, thickness variations were reduced from over 20% to the neighborhood of 10%. This brought the average thickness variation of the packing combination down but more improvement was desired.

Attempts were made to laminate at higher pressures, but while this reduced thickness variations somewhat more, density of the material increased above the desirable limits, and the resulting packing was too hard for optimum results. However, even with higher pressures, the within-sheet thickness variation was never reduced to less than ±.00075" in the thicknesses commonly employed.

It has been established that the preferred apparent density (basis weight of the sheet in pounds per 17" x 22" 500 sheet ream divided by thickness or caliper in mils) is between about 5 and 6. Packing material with apparent densities lower than this range are too soft causing undesirable embossing of the printed sheet and tend to mat down after short use, while material having densities above this range tend to be too hard and often cause ink smearing and other undesirable effects.

In accordance with this invention, it is now possible to produce an elastomer impregnated cellulose fiber material as a resilient packing member in which the within-sheet thickness variation is reduced to substantially less than ±.00075", and preferably to less than ±0.00025", or in the thicknesses now commonly used for packing impression cylinders, to less than 2%.

In one method of producing the improved packing material of this invention, a waterleaf paper comprised primarily of alpha-cellulose fibers is saturated with from 50 to 70 parts by weight of an aqueous dispersion of a heat-curable elastomer. The saturated material is then heat-cured for several hours at elevated temperatures. The cured material is then brought up to the preferred apparent density of between about 5 and 6 by passing it through several pressure nips of a supercalender. The number of nips and pressures employed in the supercalender are not critical and may be readily adjustable to obtain the desired apparent density of from about 5 to 6. This supercalendering operation also reduces gross within-sheet thickness variations to about 10% of the total thickness. After supercalendering, several plies of the material are laminated together by interposing a glue line comprising an aqueous dispersion of a heat-curable elastomer between plies and winding up the plied material. Moisture in the wet glue line application assists in conditioning the laminate to a moisture content of about 5% in which condition the laminate exhibits its best dimensional stability for later processing and use.

After supercalendering and lamination, the laminated material was found to have a within-sheet thickness variation of about ±.0026". While the average apparent density of the material at this stage is within the optimum range of resiliency for high quality printing, and the product was so used without further processing, it was found that local disuniformities in the printing pressures during use caused by similar local disuniformities in thickness and density detracted from printing quality to some extent.

It has now been found that most of the local disuniformities in thickness of the packing material can be eliminated by carefully grinding off a portion of one surface in an amount less than the thickness of one ply. Conventional microsanding apparatus called a micro-grinder, commonly used in processing fine glove leather and in grinding down decorative laminates to provide a level surface on the attachment side, is readily adaptable for this purpose. One such type of apparatus is manufactured and sold under the tradename Lightning Micro-Grinder by the Curtin-Hebert Co., Inc. of Gloversville, N.Y. A simple cross section of such an apparatus is shown in FIG. 4 for purposes of illustration and is described hereinafter. It is also noted that in order to satisfactorily grind the packing material as desired, the machine must be carefully adjusted to minimize mechanical variations. Such adjustments are also further described hereinafter.

When a grinding operation was first contemplated, it was believed that it would be necessary to grind down both sides of the laminated material to remove disuniformities or high spots from both sides. Surprisingly, it was discovered that when the grinding apparatus is properly adjusted and only one side of the sheet ground down in an amount sufficient to remove between about 5% to 20% of the total thickness, but less than the thickness of one component ply, maximum within-sheet caliper variation is reduced to less than ±0.00025", which in the thicknesses now comonly used for packing amounts to about 2%. This reduction in within-sheet caliper variation is a vast improvement over any packing material hitherto produced. Thus, for example, if the original thickness of the laminate was .026" and after grinding was .022", the within-sheet thickness or caliper variation was less than ±0.00025", i.e., ±1% or a total variation of about 2% of the total thickness, compared to a thickness variation of about .0026" before grinding. While a within-sheet thickness variation of less than ±0.00025" is achieved in the preferred form of the invention, it is intended to cover any improvement in reducing the degree of disuniformity in thickness of laminated packing material by the microgrinding technique. For example, anything less than ±.00075" in within-sheet thickness variation is an improvement over prior materials.

The flow diagram of FIG. 1 briefly outlines the sequence of steps employed to produce the preferred embodiment of the improved packing material.

FIG. 2 shows, in greatly enlarged cross section, the packing material after supercalendering and lamination, but before grinding. Individual plies indicated at **5**, **6** and **7** show thick and thin areas. These thick and thin areas are inherent in the papermaking process and are present no matter how good the sheet formation may be. Thickness variations, caused by random mating of such thick and thin areas during lamination, are present in the material at this stage and are shown in the areas marked by opposing arrows **8**, **9** and **10**. To the unaided eye, the material at this stage appears to be uniform in both thickness and density. However, by applying calipers to randomly selected areas of the sheet, it is found that within-sheet thickness actually varies considerably. For example, assuming that the average thickness of the laminated sheet is .026", a measurement taken at point **8** shows the actual thickness in that area to be about .031"; at point **9** about .029"; and at point **10** about .024". Thus, measurable thickness variations are in the neighborhood of ±.0026".

After microgrinding, layers **5** and **6** are relatively unchanged as shown at **5***a* and **6***a*, but a major portion of layer **7** is removed, as shown at **7***a*, and the configuration of the surface of **7***a* is changed to reflect the contour of the surface of layer **5***a*. Apparently when the sheet is passed through the microgrinder, more material is removed from the thicker areas than from the thinner areas thus minimizing both density and thickness variations. In the microground sheet, caliper measurements taken at **8***a*, **9***a* and **10***a* are relatively uniform. Again, assuming that an average of .004" of material was removed by the grinding, measurements taken at **8***a*, **9***a*, and **10***a* now show the material to be a uniform .022" thick with variations of less than ±.00025". To the unaided eye, the finished material looks uniformly thick as before, but in the microground material this uniform appearance is an actuality and may be affirmed by random caliper measurements.

As noted previously, it first appeared that in order to obtain in the packing material a thickness uniformity within the desired limits, it would be necessary to remove high spots by grinding both sides of the laminated material down to a plane parallel to the lowest spots. However, the unexpected mirror conformation of the contours on both sides of the sheet to each other when only one side was microground proved the anticipated double grinding unnecessary.

For a better understanding of the invention, a simple cross sectional view of a standard microgrinding apparatus is illustrated in FIG. 4. It comprises a work table **11**, over which the packing material **12** is fed under guard **13** through feed rolls **14** and **15**, and guide plates **16** and **17**, into grinding nip **18** formed by abrasive paper wrapped grinding cylinder **20** and vertically adjustable pressure roll **21**. The ground material passes from the grinding nip **18** over guide plate **26** through discharge rolls **23** and **24**. Pressure roll **21** and feed rolls **14** and **15** are frictionally driven by drive roll **22**. Discharge rolls **23** and **24** are also frictionally driven by intervening roll **25** and pressure roll **21**. Grinding cylinder **20** is independently driven and turns in a direction opposite to the movement of the material being ground with speed adjustable as desired. Depth of cut may be controlled by adjusting the speed of grinding cylinder **20** and the height of pressure roll **21**. In normal operation, the material is fed forward at the rate of about 3/16" per revolution of the grinding cylinder **20**. It its understood that various changes in speed and mode of operation may be made without departing from the spirit of this invention.

Because of the close tolerances required in the specification of the finished material, it was found necessary to make certain mechanical adjustments in the microgrinder to eliminate operating variables. For example, the heat from grinding and from pressures exerted on the bearings of the grinding cylinder caused the cylinder to expand disproportionately from center to end. The microgrinder is normally equipped with a cooling water system to keep the cylinder cool and ostensibly reduce disproportionate expansion. However, it was found that the cooling water must be recirculated and its temperature controlled to obtain optimum results. Also, it was found that heat generated by the bearings was transferred to the cylinder ends causing a gradient in temperature whereby the ends expanded more than the center, and caused proportionately more material to be removed from the edges of the sheet as it was being ground. This is overcome by water-jacketing the bearing ends, and recirculating all the cooling water through a storage tank in which the water temperature is controlled at slightly above room temperature.

Also, the grinding roll and pressure roll were found to be slightly eccentric or out of round, which adversely affected the grinding results. This is corrected by first grinding the pressure roll to substantial roundness, utilizing the abrasive paper wound grinding cylinder and running the grinder under conditions such as are used in the regular grinding operation. Then, the eccentricity is removed from the grinding cylinder, by stripping it of abrasive paper, turning the paper grit side up, and manipulating the abrasive paper between the pressure roll and grinding cylinder until the latter too is ground to substanial roundness.

If these truing adjustments are not made before grinding the packing material, the material will be ground down to a maximum within-sheet thickness variation of about ±.00075". While this latter is an improvement over the unground sheet, it is nowhere in the range of improvement which can be obtained when proper adjustments, in the equipment are made as described herein.

Best results are obtained when the material is microground while it has a moisture content of about 5%, since the laminated product was found to have optimum dimensional stability at such moisture content. It was also found that the best method of grinding was first to remove the major portion of the material on the microgrinder by employing a coarse sandpaper of about 120 grit silicon carbide on the grinding drum on the first pass through the grinder, followed by a second pass through the grinder employing a finer 220 grit silicon carbide sandpaper to grind the sheet down to the desired caliper. The sheet to be ground should be passed through the grinder in its machine, or grain, direction. Equally good results can be obtained by employing the fine grit abrasive paper for the entire operation, using more than two passes through the grinder. However, in the interest of time and process economy the employment of a first coarse grinding step to remove the major portion of material is preferred. While the sheet may be run through the grinder in the same direction for each pass and still obtain the desired results, it has been found that if the direction is reversed on the second pass, optimum results are obtained.

The following example will more clearly illustrate one specific embodiment of the invention. It is given by way of illustration only and is not intended to limit the scope of the invention.

A waterleaf saturating paper having a basis weight of about 27 lbs. per 17" x 22" 500 sheet ream was formed on a conventional Fourdrinier paper machine. The furnish comprised about 15% bleached hardwood sulfite pulp and 85% bleached spruce kraft pulp. Both pulps were caustic extracted and thus consisted primarily of alpha-cellulose fibers to provide the paper sheet with the most uniform formation possible.

The paper was saturated with a 36% aqueous dispersion of a heat-curable synthetic elastomer comprised of a butadiene-acrylonitrile copolymer compounded with selected curing agents. In this specific instance, the saturant consisted of 100 parts by weight of a copolymer of 68½ percent butadiene and 31½ percent acrylonitrile, 5 parts phenol-formaldehyde resin, 2 parts sulfur, 2 parts butyl zimate, 3 parts zinc oxide and 3 parts non-ionic soap. Actual pickup of saturant by the paper was about 65 parts of saturant solids per hundred parts of bone dry fiber.

The saturated paper was cured at 225° F. for about 5½ hours. After curing, the treated paper was measured and found to have an average thickness of about .0101" and an apparent density of about 4.5. The cured paper was then run through an eight nip supercalender at sufficient pressure to give the paper an apparent density in the range of 5 to 6. In this example, the supercalender condensed the paper to an average thickness of about .0079" and an apparent density of about 5.4. Within-sheet caliper variation was in the range of about 10%. Three plies of the supercalendered paper were then laminated by interposing between the plies a coating of about 9 lbs. per ream of a 60% aqueous dispersion of a butadiene-acrylonitrile copolymer and pressing the plies together on a wind-up roll. The laminated paper was then conditioned to a moisture content of about 5%.

The laminated material was measured and found to have an average thickness of .02595″ and an apparent density of about 5.6. Within-sheet caliper variation was in the range of ±.0026″, i.e., about ±10%.

The laminated and conditioned material was then microground on one side by passing it through a microgrinder adapted in the manner described, first in one direction using a 120 grit silicon carbide paper on the grinding cylinder, and then in the opposite direction using a 220 grit silicon carbide paper on the grinding cylinder. In the first pass, approximately .004″ of material was removed. In the second pass about .001″ of material was removed. The microground side had a smooth suede-like finish.

The resulting material had an average caliper of .02196″, an apparent density of 5.7, and a within-sheet caliper variation of less than ±.00025″.

The finished material was installed as the packing material on a high speed four color press using the following makeready assembly. Conventional unoiled manila tympan was first applied to the impression cylinder in a thickness of about .010″. Then the packing material of this invention was applied. A top sheet of oiled hard manila tympan completed the packing. The total height over the impression cylinder bearers was about .002″ to establish the printing pressure.

The packed press was run for over one million impressions with excellent half tone reproductions and markedly improved trapping of color in heavy coverage areas when compared to results obtained employing older type packings. In addition, less makeready time was required.

It was also found that after shorter runs of 200,000 to 500,000 impressions, the improved packing material of this invention could be reused by wiping the surface with kerosene and recovering the packing with a new conventional manila tympan sheet.

It has also been found that when foreign material passed through the printing nip causing batters of sufficient severity to penetrate the tympan sheet and damage the packing material, repairs could be made by simple local application of a small amount of glycerine. More seriously damaged packing sheets may be replaced with complete assurance that the replacement sheet will equal the previous sheet within at least one thousandth of an inch, thus cutting down on potential time-consuming and expensive repacking time.

While the emphasis throughout this specification describes the preferred embodiment of the packing material as being of laminated construction, it is possible to make a less satisfactory, but still serviceable, material by forming the base sheet sufficiently thick so that only one ply is required. Suitably thick sheets can be made on conventional cylinder or board machines. Even though formation on these machines is usually not as uniform as can be obtained on Fourdrinier machines, when such a sheet is saturated, cured, supercalendered, and microground as herein described, most of the improved characteristics will be attained.

The preferred elastomer is a butadiene-acrylonitrile copolymer containing from about 55 to 80 percent butadiene and about 20 to 45 percent acrylonitrile. Other elastomers which may be used included materials such as butadiene-styrene copolymers, natural rubber, polychloroprene, copolymers of an alkyl acrylate and an unsaturated carboxylic acid, copolymers of an alkyl acrylate, an unsaturated carboxylic acid and an alkyl methacrylate, polymerized methyl, ethyl or butyl acrylate, or methyl, ethyl, or butyl acrylate copolymerized with acrylonitrile or ethyl, methyl, or butyl methacrylate, and the like. The hardness of the sheet can be controlled by judicious selection of the saturant from this group.

Impregnating is usually done from an aqueous dispersion although solutions in suitable solvents may also be used. The amount of solids in the impregnating medium may range from about 20 to 40 percent. The desirable degree of retention is from about 50 to 70 parts by weight of solids per 100 parts of dry fiber although he amount of retention may range from about 35 to 140 parts of solids per 100 parts of dry fiber and still be satisfactory for some uses. Alternatively, the elastomer may be added in the beater and precipitated on the fibers before the sheet is formed. In this case, the saturating step is omitted. However, the elastomer must still be cured in situ before supercalendering.

In addition to the elastomer, the impregnating mixture usually contains special additives to enhance certain specific properties. These additives include curing agents such as zinc oxide, sulphur, zinc dibutyl dithio-carbamate or dicumyl peroxide; resins such as phenol formaldehyde; fillers such as clay, carbon black, and one or more of the carbonates, dyes and pigments.

It is understood that overall thickness of the laminated packing material may be varied to meet the needs and requirements of the printing industry. In any event, in carrying out the preferred embodiment of the invention as taught herein, the variation in thickness will never exceed ±.00025″ which in the thickness currently preferred by the printers is less than ±2%.

The unusually low within-sheet thickness variation obtained in the packing material as described herein enables the printer to pack impression cylinders to a lesser height over the bearer strips than hitherto possible so that satisfactory printing runs may be made with less pressure in the printing couple. This allows the printer to exercise better control over the printing process, enables the use of inks with closer tackiness values, and protects against serious damage from batters caused when extraneous material or extra thick paper is inadvertently passed through the nip during printing.

We claim:

1. An improved packing material for letterpress impression cylinders, said material being of uniform density and thickness and comprising a unitary laminate of cellulosic fiber webs impregnated with and bonded by an elastomer which has been heat-cured in situ, said fibers consisting primarily of alpha-cellulose fibers and said elastomer comprising a butadiene-acrylonitrile copolymer containing from about 55 to 80 percent butadiene and about 20 to 45 percent acrylonitrile, said laminate and its component webs having an apparent density of about 5 to 6 obtained by heat-curing the elastomer impregnant in the component webs and subsequently supercalendering the cured webs to the desired density before lamination, one side of said laminate has a smooth suede-like finish obtained by microgrinding said laminate to a depth less than the thickness of one component web and sufficient to remove local areas of disuniformity in thickness and density, said microground laminate having a maximum within-sheet thickness variation of less than ±.00075″.

2. The improved packing material of claim 1 in which the elastomer is present in the amount of about 35 to 140 parts by weight per 100 parts of dry fiber.

3. An improved packing material for letterpress impression cylinders, said material being of uniform density and thickness and comprising a unitary laminate of cellulosic fiber webs impregnated with and bonded by an elastomer which has been heat-cured in situ, said fibers consisting primarily of alpha-cellulose fibers and said elastomer comprising a butadiene-acrylonitrile copolymer containing from about 55 to 80 percent butadiene and about 20 to 45 percent acrylonitrile, said laminate and its component webs having an apparent density of about 5 to 6 obtained by heat-curing the elastomer impregnant in the component webs and subsequently supercalendering the cured webs to the desired density before lamination, one side of said laminate has a smooth suede-like finish obtained by microgrinding said laminate to a depth less than the thickness of one component web and suffi-

cient to remove local areas of disuniformity in thickness and density, said microground laminate having a maximum within-sheet thickness variation of less than ±.00025".

4. The improved packing material of claim **3** in which the elastomer is present in the amount of about 35 to 140 parts by weight per 100 parts of dry fiber.

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