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SMASH-RESISTANT OFFSET PRINTING BLANKET

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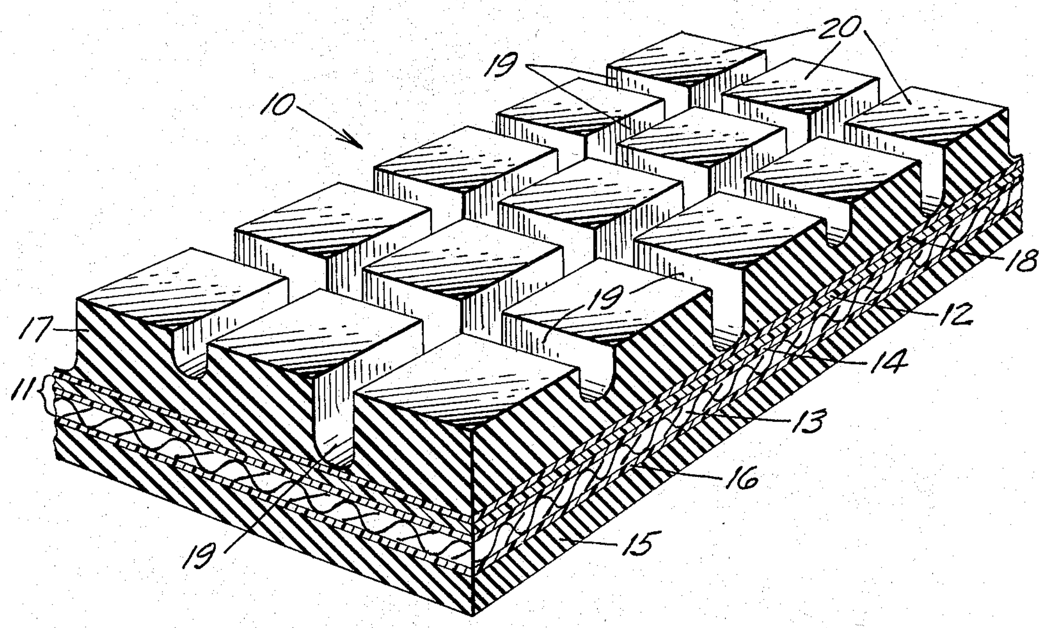

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SMASH-RESISTANT OFFSET PRINTING BLANKET
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This invention relates to cylinder covers for printing presses and is particularly concerned with blankets for use in lithographic offset printing.

This application is a continuation-in-part-of my co-pending application Serial No. 136,954.

In offset lithography a rotary cylinder is covered with a printing plate which has a positive image area receptive to oil-based inks and repellent to water and a background area receptive to water and repellent to ink. The plate is then contacted with both water and an oil-based ink, thereby inking the image area and moistening the background area. The cylinder on which the plate is mounted is then rotated so that the surface of the plate contacts a second cylinder covered with a rubber-surfaced ink-receptive printing blanket. The ink present on the image area of the plate transfers, or offsets, to the surface of the blanket. Paper or other sheet stock to be printed is then passed between the blanket-covered cylinder and a rigid backup cylinder thereby again transferring the ink from the printing blanket to the paper.

During both the step in which the image is transferred from the plate to the blanket and the step where the image is transferred from the printing blanket to the paper, it is important to have intimate contact between the two contacting surfaces. This is ordinarily achieved by positioning the blanket-covered cylinder and the cylinder it contacts so that there is about 3 mils of "interference," i.e., so that the printing blanket is compressed to a depth of about 3 mils throughout the run. It is important that this compression be maintained and that the surface of the printing blanket remain uniform, else the resulting printed paper will not be uniform and legible. Conventional blankets tend to compress gradually in use, necessitating constant readjustment of the press settings to prevent "fade-out." A blanket which has been used to print envelopes cannot thereafter be used to print paper, "ghosts" of the envelope appearing on the sheets. It also occasionally happens that paper shreds or wrinkled or folded sheets are inadvertently fed through the press, thus compressing a portion of the printing blanket beyond its usual depth and causing localized absence of printing. Even more serious, misfeeds may occur in which extra sheets of paper cause a "smash" or severe compression of a major portion of the printing blanket. If permanent compression, or "set," results from such accidents, adjustments to the equipment—or even replacement of the blanket—must be made to avoid irregular or totally unsatisfactory printing.

For many years, conventional printing blankets have been made by laminating together several plies of fine grade cotton cloth and applying a printing surface of approximately 20 mils of oil-resistant rubber. Rubber is resilient but essentially incompressible; i.e., under severe load it maintains a constant volume by distorting sideways. Thus, in the event of a misfeed or smash in offset lithography, a conventional printing blanket necessarily decreases in thickness primarily by permanently compressing the cotton cloth. Repair of the printing blanket in such event involves swelling the rubber printing surface with solvent, meticulously inserting sheets of paper beneath the blanket in the smashed areas, etc; these repairs are, at best, hard and slow to perform. Further, even ordinary printing runs tend to impart a

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significant degree of permanent "set" to these blankets and thus reduce their effective life. A misfeed which occurs after a blanket is compressed in this manner may actually spring the press.

Because of the known drawbacks to conventional printing blankets, attempts have been made to produce improved blankets for well over half a century. These attempts have included incorporating springs in the printing blanket, replacing the cotton fabric with metal sheeting, and employing a layer of high void volume sponge rubber. Embossed rubber layers have also been applied to the back of otherwise conventional printing blankets, as in Rhodes U.S. Patent 752,105. To the best of my knowledge, all these attempts have resulted in products which were expensive, unyielding, subject to compression set, or otherwise unsatisfactory. As a result today's printing blanket is still the traditional kind formed from multi-ply cotton fabric surfaced with oil-resistant rubber.

I have now devised a novel printing blanket which maintains sharp images for long periods of use in offset lithography without significant wear, which is strong yet flexible and conformable, which can be temporarily compressed to a substantial extent, but which is highly resistant to permanent damage. This blanket requires no break in period and does not "fade" in use. The press man is able to alternate thick and thin stock of varying width without even resetting the press.

My invention comprises the combination of a strong, flexible kink-resistant low-stretch foundation sheet material sandwiched between a fairly conventional ink transfer layer and a readily yieldable resilient support layer formed of essentially incompressible resilient material, e.g., oil-resistant rubber. An essential component is a foundation formed of a strong low stretch fabric such as saponified cellulose acetate, available from Celanese Corporation of America under the trade designation "Fortisan," or glass cloth. Although a single ply foundation can be employed, I have found it convenient to use a two-ply structure to facilitate processing, as will become apparent from the further description of my invention.

The attached drawing is a perspective view of sheet stock used in preparing printing blankets in accordance with my invention. In the drawing, printing blanket **10** comprises foundation **11**, which in turn is made up of oriented polymeric film **12** and strong woven synthetic cloth backing **13**, unified by adhesive layer **14**. To the opposite surface of synthetic cloth backing **13** an ink transfer layer **15** is adhered by adhesive **16**, and to the surface of polymeric film **12** resilient compressible support layer **17** is adhered by adhesive layer **18**. Support layer **17** is externally subdivided by grooves **19**, leaving flat-surfaced islands **20** a functionally equivalent form of this structure, in which foundation **11** is inverted for convenience of manufacture, will be further described and explained with the aid of an illustrative but non-limiting example, all parts being by weight unless otherwise noted.

Example

A 5-mill film of biaxially oriented polyethylene terephthalate was primed by briefly immersing it in a 10% solution of parachlorophenol in trichloroethane, and passing the film between rubber squeeze rolls, after which the coated film was dried to evaporate the solvent. To one surface of the primed polyester film was now applied an adhesive coating made by blending 100 parts of "Hycar 1001," 20 parts of dioctyl phthalate, 80 parts of a 50% methyl isobutyl ketone solution of an oil-soluble phenol formaldehyde resin ("Durez 14296"), and 80 parts of "Epon 828," after which the solvent was evaporated by heating for 5 minutes at 275° F., leaving a slightly tacky adhesive film approximately 2.5 mils in thickness. ("Hycar 1001" is a 60:40 butadiene:acrylonitrile rubber having a Mooney viscosity in the range of 80–110. "Epon 828" is essentially the diglycidyl ether of bisphenol A.)

To the adhesive-coated surface of the polyester film was now applied approximately 22 mils of a fairly conventional ink transfer layer, viz., "Hycar 1042 x 82," (a 67:33 butadiene:acrylonitrile rubber having a Mooney viscosity in the range of 70–95 and characterized by low shrinkage in processing) compounded with conventional clay and calcium carbonate fillers, accelerators, etc., to yield a rubber which, when cured, has a Shore A–2 hardness of approximately 55–60 durometer (ASTM Test D 676–55T). After calendering the rubber layer onto the polyester film backing, the material was wound on itself in roll form and cured for 6 hours at 275° F. To the other primed surface of the polyester film was next applied a coating of the adhesive described in the preceding paragraph and the solvent evaporated to leave a film having a thickness of about 3 mils. This intermediate sheet material, which had a thickness of approximately 30–32 mils, was wound on itself in roll form until further needed.

A 25-inch wide crowfoot weave continuous filament saponified cellulose acetate rayon cloth having an 80 x 50 thread count, formed from 270 denier threads, having a nominal thickness of 10–11 mils and weighing 5 ounces per square yard, was primed on one surface with a blend of 100 parts "Hycar 1001," 20 parts of dioctyl phthalate and 40 parts of "Durez 14296," the primer having a stringy consistency and a viscosity of approximately 6000 cps. The primer was then dried to a slightly tacky condition, the thus-coated saponified cellulose acetate fabric being capable of being wound on itself in roll form and thereafter unwound without adhesive transfer. To the primed surface was next calendered a rubber composition formed by adding the following materials to a cold rubber mill and mixing one hour:

	Parts
"Hycar 1042"	100.0
Zinc oxide	5.0
SRF carbon black	56.0
FEF carbon black	38.0
Di-butoxy ethyl sebacate	20.0
N-nitroso diphenyl amine	2.0
Stearic acid	1.5
Sulfur	1.65
Benzothiazyl disulfide	1.35
Tetra methyl thiuram monosulfide	0.22

The nature of this rubber composition is such that when cured and tested in accordance with ASTM Test D 676–55 T the rubber has a Shore A–2 hardness of 77–78 durometer. The rubber composition was preheated on a warm-up mill and then calendered onto the saponified cellulose acetate, the calender rolls being maintained at about 200° F. The total caliper of the structure was found to be approximately 32 mils.

Using laminating rolls heated to 300° F., a 16 mesh wire screen formed from 16 mil wire was forced into the uncured calendered rubber layer and the product wound into roll form. After curing for 6 hours at 275° F., the screen was removed, and the resultant intermediate product was found to be 39–41 mils thick.

The two intermediate products, i.e., the rubber coated polyester film and the embossed rubber-coated "Fortisan" fabric, were laminated on heated squeeze roll equipment, the two rubber layers forming the exposed portions of the composite structure. The bonding adhesive was then cured by heating the structure, in roll form, for 8 hours at approximately 260° F. The laminate, having a thickness on the order of 72 mils, was rendered of uniform caliper and smooth surface configuration by grinding the unembossed rubber face on a conventional drum sander

provided with Grade 150 coated abrasive material, and thereafter polishing to remove the grinding marks. The finished structure had an overall thickness of 67 mils.

The product of this example was tested by placing it under a load of approximately 1 lb. per square inch, i.e., minimum contact pressure of the caliper gauge. Pressure was then increased to 100 lbs. per square inch, and it was noted that the caliper had decreased between 3 and 4 mils. When the pressure was further increased to 1000 lbs. per square inch an additional decrease in caliper of approximately 4–5 mils was noted. When the pressure was again reduced to 1 lb. per square inch, the total compression set was only about ½ mil. It should be noted that 100 lbs. per square inch is fairly comparable to the pressure encountered in normal printing operations, while 1000 lbs. per square inch is typical of the pressure to which a printing blanket is subjected in a "smash" or misfeed. When tested in an identical manner, the best available printing blankets of the type known prior to my invention compress approximately the same amount, but their recovery is inferior, 3 to 4 mils total compression set being fairly typical. This difference can also be observed in a conventional printing operation, where ordinary printing blankets typically "fade" 2 or 3 mils—and often even 4 or 5 mils—in the first day of operation, requiring the press operator to constantly adjust the pressure to produce acceptable printing results. In contrast, printing blankets made in accordance with my invention can immediately be set at 3 mils interference require no break in period, and show no detectable tendency to "fade," even after running for a period of weeks.

The unusual superiority of blankets made in accordance with my invention can also be clearly demonstrated by a fairly conventional situation which frequently arises in small job shop printing operations. It is common for such shops to print a run of paper, then a run of envelopes, and then more paper. Since the envelopes are both narrower and thicker than the paper, it is necessary to change printing blankets every time the work is changed. If this is not done, the pressure will be improper and, even worse, the printed paper will tend to show "ghosts" in the areas where the thicker envelopes have locally compressed the blanket. Surprisingly, and for the first time in the industry, insofar as I am aware, my novel blanket makes it possible to consecutively print work of widely varying widths and thickness without having to worry about the appearance of the finished printing.

The product of the foregoing example has a machine direction elongation of about 1.5% and a cross direction elongation of about 1.8% when subjected to a force of 50 lbs. per inch. This nearly "square" characteristic, although not absolutely essential, is highly desirable, since blankets may then be cut in whatever manner most economically uses the sheet material.

Certain changes may be made in the specific structure disclosed in the foregoing example, as will be shortly pointed out, but there is a surprising criticality to the parameters involved. Permissible latitudes of the various components will now be discussed in somewhat greater detail.

It is convenient to use a biaxially oriented polyethylene terephthalate film as one component of my novel printing blanket. This material is strong and tough, its caliper is uniform, and there is no tendency whatsoever for print-through of the embossed configuration of the resilient support layer. For certain operations, biaxially oriented polypropylene, polycarbonates, or other films may also prove suitable. I have found that one full equivalent for the polyester film is a continuous filament glass cloth, e.g., one having a 60 x 58 thread count, a nominal thickness of 4 mils, and weighing 3.16 ounces per square yard. In some ways the glass cloth is actually superior to the polyester film described, since it totally eliminates any "kinking" problem. Kinking sometimes occurs when a printing blanket is carelessly handled, so that it is bent back sharply on itself at 180°. Under such circumstances, oriented polyster film may occasionally retain evidence of the bending and slightly distort the printing blanket itself. Although this problem is minor, the use of glass cloth totally obviates the difficulty. In like manner, glass cloth can be substituted for the saponified cellulose acetate employed in the specific structure described hereinabove. If desired, a single glass fabric of appropriately increased strength can be used to replace both the polyester film and the saponified cellulose acetate fabric; such a structure, however, obviously necessitates some changes in the processing of the finished product. At any rate, the finished product should have a tensile strength of at least about 175 lbs. per inch of width, since a printing blanket is typically applied under a tension of, say 50 lbs. per inch and certain printing blankets have "ears" which localize the pressure applied.

One of the most significant features in printing blankets made in accordance wtih my invention is the resilient compressible support layer. Although rubber itself is notoriously incompressible, the specific structure described provides void spaces into which the rubber can distort laterally when subjected to a heavy pressure. In order to insure conformance to the printing cylinder and regularity of the printing surface, it is important that the exposed surface of the support layer be essentially planar. The width of the embossed grooves is preferably on the order of $\frac{1}{32}$–$\frac{1}{64}$ inch, and should certainly not exceed $\frac{1}{16}$ inch, or it is likely that a pattern will be transmitted to the material being printed. The exact thickness of this support layer can probably vary within the range of 10–50 mils, but is preferably 20–40 mils. Almost all the compression which occurs will take place in this layer, and if the thickness is less than 10 mils, it will be almost impossible to secure the 5 mils compression in this layer alone. On the other hand, if the thickness of this layer exceeds about 50 mils, the blanket is rendered unduly stiff, no additional purpose is served, and, to conform to existing equipment it is necessary to reduce the thickness of the other component layers. The support layer should be made up of rubber having a Shore A–2 hardness of at least about 60 durometer and preferably about 75–85. If the support layer is significantly softer than this, it will be impossible to obtain an additional 3 mils compression when the loading is increased from 100 to 1000 p.s.i., as is likely to occur in a "smash" or misfeed.

The support layer should contain at least about 5×10^{-3} cubic inches of voids per square inch of blanket surface, but the total void volume should not exceed about 40%. If the void volume is less than 5×10^{-3} cubic inches either the compressibility will be too low (if the rubber is relatively hard) or it will be impossible to obtain the additional 3 mils compression when the pressure is increased from 100 to 1000 p.s.i. (if the rubber is soft). If the void volume exceeds about 40% it will be possible to obtain adequate compression at 100 p.s.i. if a sufficiently hard rubber is used, but increasing the loading to 1000 p.s.i. does not provide the necessary additional compression.

The compressibility of the resilent support layer is also important. If the structure does not compress at least 1 mil under a loading of 100 p.s.i., it will not conform well to the printing cylinder or to the work being printed. On the other hand, if the compression under this loading exceeds 5 mils, it is extremely difficult to set the press accurately. As noted, if the compression between the loading of 100 p.s.i. and 1000 p.s.i. is not at least 3 mils, a "smash" will either permanently deform or distort the blanket or actually spring the press itself.

It is also important that the stretch of the finished product be no more than about 2% under a tension of 50 lbs. per inch of width. If this stretch figure is exceeded, installation of the blanket is likely either to decrease the overall thickness of the blanket or to necessitate frequent readjustment.

The specific support layer described herein is simple to

make, convenient, and precise. On the other hand, any other support layer having the same compressibility parameters and void volume content can also be employed. For example, a foamed rubber having a planar back surface and a void volume within the described ranges may be employed, but the resultant product is likely to be appreciably stiffer and hence less convenient to use. For the same reason, I generally prefer that when the support layer is embossed, as previously described, the grooves should be external rather than internal.

What I claim is:

1. A thin, strong printing blanket especially suitable for use in offset lithography, where it can be subjected to localized pressures caused by misfeeds or accidental debris, under which conditions it compresses to avoid damaging the blanket or the press itself but upon the removal of the compressive force regains substantially all of its original thickness, said printing blanket comprising in combination: a strong thin tough synthetic foundation sheet sandwiched between and firmly adhered to an oil-resistant continuous rubber ink transfer layer and a resilient compressible support layer, said support layer being formed from rubber, the rubber of said support layer having a Shore A–2 hardness of at least about 60, when void-free said support layer having up to 40% uniformly distributed voids into which the rubber in said support layer can distort when said blanket is subjected to force normal to its surface, said support layer containing at least about 5×10^{-3} cubic inches of voids per square inch of blanket, said support layer when formed per se compressing on the order of 1–5 mils under the first 100 lbs./square inch pressure applied and at least an additional 3 mils under an additional 900 lbs, of pressure, said foundation sheet having a tensile strength of at least 175 lbs. per inch of width in the machine direction and an elongation of no more than about 2% under a tension of 50 lbs. per inch of width.

2. The product of claim **1** wherein the blanket is on the order of $\frac{1}{16}$ inch thick and the support layer is about 20 to 40 mils thick.

3. The product of claim **1** wherein the foundation sheet essentially comprises a strong woven synthetic fabric.

4. The product of claim **3** wherein the fabric is formed from saponified cellulose acetate.

5. The product of claim **3** wherein the fabric is formed from glass fibers.

6. The product of claim **1** wherein the foundation sheet comprises a biaxially oriented polyethylene terephthalate film.

7. The product of claim **1** wherein the foundation sheet comprises a laminate of a strong woven synthetic fabric and a strong oriented synthetic polymeric film.

8. The product of claim **7** wherein said film is biaxially oriented polyethylene terephthalate.

9. A thin, strong printing blanket especially suitable for use in offset lithography, where it can be subjected to localized pressures caused by misfeeds or accidental debris, under which conditions it compresses to avoid springing the press but upon the removal of the compressive force regains substantially all of its original thickness, said printing blanket having a thickness on the order of $\frac{1}{16}$ inch, a tensile strength of at least about 175 lbs. per inch of width, and no more than about 2% elongation under a force of 50 lbs. per inch of width, comprising in combination: a strong thin tough foundation sheet comprising a laminate of a highly polymeric oriented polyethylene terephthalate film and a strong woven synthetic fibrous sheet, said foundation sheet sandwiched between and firmly adhered to an oil-resistant continuous rubber ink transfer layer and a 10–50 mils thick resilient compressible support layer, said support layer being formed from rubber, the rubber of said support layer having a Shore A–2 hardness in the range of about 75–85 when formed void-free, said support layer being divided at its exposed surface into islands by grooves which are no more than about $\frac{1}{16}''$ wide and which extend at least a substantial distance toward the interface between said film and said support layer, thereby providing up to about 40% voids into which the material in said support layer can distort when said blanket is subjected to force exerted normal to its exposed surface, said support layer containing at least about 5×10^{-3} cubic inches of voids per square inch of blanket.

10. The product of claim **9** wherein said sheet has approximately the same tensile and stretch characteristics in both machine and cross directions.

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