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METHOD OF MAKING POWER TRANSMISSION LEATHER BELTS

Sherman D. Lesesne, Worcester, Mass., assignor to Graton & Knight Company, Worcester, Mass., a corporation of Massachusetts

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1

This invention relates to power transmission leather belts and more particularly to a method of making a leather belt from two strips of leather cemented together, either end to end or in multi-ply layers or both.

Heretofore, a belt has been made in accordance with the methods and apparatus described in the patents to Griffith #1,863,595 and #1,863,596 of June 21, 1932. In accordance therewith, strips of leather are initially skived to provide bevelled edges, and they are joined end to end to form long strips. These are then cemented together by mans of an intermediate strip of Celluloid which has been softened on its surface by a suitable solvent, such as acetone. The leather strips are placed under tension and subjected to pressure to force the Celluloid into the surface pores. This pressure has been applied by means of a long series of rolls, but a preferred practice has been to clamp the assembled belt layers and Celluloid between pressure plates which hold the belt under pressure for an hour or more and until the cement has set to a desired extent. This procedure has involved tying down considerable equipment, as well as a large expenditure of labor and time. Moreover, passing the assembled belt strips through a succession of pressure rolls while the cement is setting tends to disturb the roots of the cemented portion, where the cement has penetrated into the pores and around the interior fibres of the leather, and so weakens the structure. The solvent applied to the Celluloid film prior to assembly tends to penetrate the leather and to leave the cement root structure soft during the time when it should be setting, and especially while it is being subjected to the pressure of a succession of rolls. Hence the final product may not have a desired strength.

The primary object of this invention is to provide a power transmission belt made of a plurality of strips of leather cemented together which is stronger and more durable than heretofore provided by the above described procedure.

A further object is to provide a method of making a power transmission leather belt which does not require the use of expensive pressure equipment for holding the leather layers together during the cement setting period and can be carried on expeditiously, economically and quickly, and wherein the major steps are accomplished automatically and with but a small amount of attention on the part of the operator. Further objects will be apparent in the following disclosure.

In accordance with my invention, I propose to cement together two or more strips of leather by

2

applying a layer of a thermosetting rubber and resin cement to the surface of each strip and then causing each layer to solidify separately in an undisturbed condition. Thereafter, the rubber resin cement, whose roots have acquired a firm hold on the leather fibres within the belt structure, is activated or made soft and tacky by the momentary application of heat to the cement surface and without materially heating the leather body or the root structure of the cement, and then the two adhesive surfaces of the leather strips are pressed together quickly while the cement is in a strongly adhesive and plastic condition. This pressure is to be applied only momentarily to force the two leather strips into firm contact and immediately thereafter the belt is rolled up for storage or otherwise treated. The cement sets during a room temperature aging stage. This procedure applies both to cementing together the bevelled ends of two strips and to making a multi-layer belt of two or more long strips cemented together in a parallel surface contact.

In carrying out this invention, short strips of leather may be first provided with bevelled edges and cemented together in accordance with standard procedure after which the long strips are cemented together as a multi-layer belt in accordance with my method. But the short strips are preferably cemented together by the procedure herein described, which involves the use of a resin rubber cement solution that has been first applied and allowed to harden by evaporation of the solvent and then has been momentarily heat softened for the assembly of the two parts. In order to make the long strips, the selected short strips cut from chrome tanned hides are skived and cut to provide bevels of a desired length and angularity. Then, each of the bevelled surfaces is provided with a cement layer, as hereinafter more fully described, and the cement is allowed to harden in an undisturbed condition. This may be accomplished by stacking the short leather strips in piles. At a later time, and after the cement has hardened, the material is heat softened and then the bevelled surfaces are immediately pressed together under a desired pressure in order to form a long belt strip. This long strip, made of the shorter strips cemented together, may be suitably treated for making a single layer leather belt; or two or more of these long strips may be cemented together as herein described to make a multi-ply belt. This invention will be more fully described as to the procedure of making that multi-ply belt, but it will be understood that the various details of the method will apply equally

to cementing the bevelled ends of the short strips together.

In order to make the multi-ply belt, each of the long leather strips may be skived to an exact thickness, if this has not been previously done, and its surface may be brushed to provide a well roughened surface having exposed fibres and open pores with which the cement may interlock. This is suitably accomplished by means of a revolving brush roll made of projecting steel wire bristles, and may be in accordance with the disclosure in the patents to Griffith #1,741,106 and #1,741,107 of December 24, 1929. These leather strips are usually provided in the form of rolls which are convenient for storage.

To make a two ply belt, two of the long leather strips are fed forward progressively, and a layer of the rubber resin cement is applied to the bristle roughened and scratched surface of each strip which is to be cemented to the other. The cement may be applied by means of an applicator roll dipping in a bath of the cement and rolling against the surface of the moving belt strip. Also, the cement may be applied by means of a spray gun or by brushing or flowing the same onto the leather in accordance with various applicable methods. The cement may be applied in a single application, or if desired, two or more applications may be made to insure that the surface pores are filled and a film covers the surface. The cement is of such consistency or viscosity that it will penetrate the porous leather strips to the required extent and the amount is sufficient to provide a substantially continuous surface layer of the cement on the leather surface. The leather strips may then be permitted to dry for a short period of time at room temperature, and if desired with the aid of a low degree of heat, such as about 80° to 95° C. or sufficient to evaporate the solvents in the cement that have held it in a thin fluid form, but without softening the cement or affecting the leather materially. If desired, the leather strips may be rolled up and put away in storage or they may be laid aside for at least an hour or until the solvents have evaporated and the cement that has penetrated the leather pores has formed strong roots, as it were, which are entangled with and wrapped around the fibres of leather and thereby make a very firm and strong junction therewith.

Thereafter, and in accordance with a primary feature of this invention, the outer exposed surface of that substantially solid and solvent free cement is activated or rendered plastic and strongly adhesive by the flash application of a comparatively high temperature, such as 200° to 220° C. for a very short time, such as 5 to 30 seconds, more or less, or which is sufficient to soften the exposed surface of the cement without heating the leather materially. This heating step is intended to make the cement layer tacky or plastic to a depth, theoretically of only a few molecules, but actually to a considerable depth but preferably not throughout the entire depth of that surface film. That is, the heat penetration should be so limited as not to disturb materially the hardened condition of the cement where it touches the leather and particularly within the pores of the leather. It is therefore important that this heat be applied only to the exposed surface of the cement and not to the leather. Hence, the use of a hot plate or a hot press which engages the under side of the leather is undesirable, because of the heat being improperly applied to the root structure of the cement and not initially

to its outer exposed cement film surface. This flash heat may be applied by various means, but I prefer to use either a blast of heated gas of the required temperature or to expose the leather strips as they move along to the intense heat of an infra red or other electric light bulb or a series of lamps having their rays directed closely against the cement layer. This lamp may be a standard incandescent resistance wire bulb of 100 or more watts, and the wattage of the lamp or a series of lamps may be suitably selected or varied to give a high enough temperature at the surface of the film to insure that it is softened materially on the surface and without heating the roots of the cement in the leather therebeneath.

While the softened cement layers are in that adhesive and tacky condition, the two belt strips are immediately pressed together with their cement layers in contact and under a sufficient pressure to insure a strong and firm union. That pressure needs to be only momentary, such as is secured by passing the assembled belt structure between two pressure rolls held under gravity or a sufficient applied pressure to insure that the two leather layers are brought into a close and firm union but without disturbing the root structure of each cement layer which has been previously converted by solvent evaporation to a substantially hard condition. It is unnecessary and inadvisable to hold the assembled belt parts between pressure plates after they have been assembled, since the pressure could do nothing more than disturb the root structures of the cement. The fact that the surface molecular layers of the two cement strips have been firmly united while in their softened condition is all that is required for the final and permanent union of these two strips by a flexible and strong rubber or modified rubber resin cement.

The use of solvents for softening the surface films is to be avoided since a solvent will not be properly eliminated when the belt strips are stuck together, and thus the solvent may work down into the root structures of the cement and loosen the same or render the belt union less strong. By my procedure, in which the root structure of the cement is not disturbed materially during the operation of sticking together the two layers, I have provided a belt in which the adhesion of the two layers is far stronger than heretofore obtainable by standard methods. For example, two belt layers immediately after being cemented together by this procedure, and without the cement being permitted to set further by aging, are found to have a tensile strength of 15 pounds per inch, as determined by the force required to tear the two strips apart at the cemented joint.

After the belt has been assembled in accordance with my method, the belt may be immediately rolled up and stored. Some further setting and aging of the cement may take place during storage and give an increased strength, depending upon the nature of the cement that has been employed, but practically, the belt is complete and ready for use soon after the parts have been pressed together since aging takes place rapidly. Also, the process may be made continuous as above described by heating the surface of the applied cement sufficient to drive off the solvent before it is flash heated, but if a particularly strong belt is to be made, it is desirable to apply the cement to the belt and allow it to dry in the air for a few minutes and then to roll up the belt strip and allow it to stand for a period

of time, such as 24 hours, during which time the volatile ingredients of the cement have adequate time for evaporation and thus leave the roots of the flexible cement in firm engagement with the fibres of the leather body. Then this roll of strip leather may be given the flash heat treatment and pressed against a similarly treated leather strip in a subsequent operation. The strips should be pressed together immediately after being flash heated and before the surface plasticity developed by the heat has been lost. This is particularly important because the cement contains thermosetting resins which react with the rubber to form an infusible and solid compound either under the application of heat or during a period of storage at room temperature.

It will now be appreciated that I may use various types of cement for the many required purposes and that the ingredients of the cement may be widely varied, depending upon the strength required and the uses to which the belt is to be put.

The preferred rubber base of the cement is a butadiene acrylic nitrile copolymer. The cement ordinarily comprises the synthetic rubber and a solvent and may include a tackifier which gives the cement a higher adhesive quality. Anti-oxidants may be added to prevent or slow down the oxidation of the rubber and minimize the production of brittleness or other undesirable characteristics. To the rubber mixture may be added 1% by weight, more or less, of a coumarone-indene-resin which greatly increases the adhesive properties or its tackiness. I may add 0.5% by weight, more or less, of zinc oxide and a like amount, more or less, of phenyl-alpha-naphthol amine to give the cement the desired aging properties or to serve as anti-oxidants.

For the resin which will react with the butadiene acrylic nitrile copolymer and form a thermosetting compound, I prefer to use a phenol formaldehyde resin or resorcinol formaldehyde resin. After the flash heating treatment, this mixture will set during a brief aging period while held at room temperature and thus form an elastic infusible compound. A suitable cement may be made of the following composition:

	Parts by weight
Butadiene acrylic nitrile copolymer	1
Phenol formaldehyde resin or resorcinol formaldehyde resin	1
Ethylene dichloride	2.5
Methyl ethyl ketone	3.5

The coumarone indene resin, the zinc oxide and the phenyl alpha naphthol amine may be added to increase its tackiness and aging properties. Various other formulas well known to those skilled in the industry may be employed and other types of resins may be added, provided the cement can be made tacky and adhesive by flash heating or able to soften under the application of the heat sufficiently to unite the two cement layers firmly together prior to its becoming thermoset. Also, the proportions of the different ingredients may be widely varied, depending upon the final properties required. For example, the rubber and the phenol or resorcinol formaldehyde resin may be used in greater or lesser amounts, although the rubber is an essential and primary ingredient of the cement and it should be present in sufficient amount to give the required adhesive properties, whether the resin or the rubber constitute the major portion of the mass. It will be appreciated that the ethylene dichloride and methyl ethyl ketone of the above formulas serve merely as solvents and that they evaporate prior to the setting operation so that the final cement consists only of the synthetic rubber and the phenol aldehyde resin. In the more complex formulas the coumarone indene resin, the zinc oxide and the amine remain in the final product.

It will now be appreciated that this method comprises essentially the steps of coating the two leather parts to be stuck together with an evaporable solution of an interacting thermosetting mixture of resin and rubber, and of allowing this cement to harden by evaporation of the solvent so as to fix its roots in the pores of the leather body. Thereafter, the exposed surface portion only of the cement film on the outside of the leather is heated to make it adhesive and tacky, and then the two leather strips are immediately pressed together. Aging of the cement at room temperature completes the thermosetting operation and the belt has substantially its required strength within a very short time or as soon as the flexible rubber resin films have become thermoset. The pressure applied is merely that which is sufficient to force the leather strips into firm contact.

Various modifications may be made in the formulas and in the steps of the procedure. Hence, it is to be understood that the above disclosure is to be interpreted as setting forth the principles of my invention and the preferred compositions and methods of making leather belts and not as imposing limitations on the claims appended hereto.

I claim:

1. The method of making a power transmission leather belt comprising the steps of cutting mating surfaces on two leather strips, initially coating said surfaces and impregnating the communicating leather pores with a solution of a synthetic rubber and a resin that form by evaporation of the solvent a cement capable of being softened by heat and wherein the rubber and resin will interact to form a thermosetting compound, evaporating the solvent and forming a solid cement coating having its roots interlocked within the leather pores, thereafter flash-heating and softening only the surface coating on each strip without materially heating the leather body and polymerizing the root structure, pressing the two heat softened cement coatings together into an integral continuous mass without disturbing the root structure materially, and causing the cement to set thereafter as an infusible thermoset elastic bonding layer between the leather parts.

2. The method of making a power transmission leather belt comprising the steps of providing two leather strips with porous mating flat surfaces, coating each of said surfaces and impregnating the communicating leather pores with an evaporable solution of butadiene acrylic nitrile copolymer mixed with a condensation product of formaldehyde and a phenol selected from the group consisting of phenol and resorcinol, evaporating the solvent and forming a surface film coating having solid roots interlocking with the leather pores, thereafter flash-heating and softening only the surface coating on each strip, without materially heating the leather body and polymerizing the root structure, pressing the plastic softened cement surfaces into a firm adhesive union without disturbing the root structure materially, and aging the cement at room temperature and causing the rubber and

the resin to interact and form a solid infusible thermoset elastic bond which cements the leather strips together.

3. The method of making a multi-ply belt according to claim 1 comprising the steps of roughening and progressively coating a surface of each of two leather strips with a solution of the rubber resin cement, evaporating the solvent at about room temperature without thermosetting the cement, thereafter moving the two strips progressively and flash-heating the coated surfaces to render them adhesive, continuously pressing the adhesive surfaces into contact between pressure

rollers, and storing the fabricated belt during a cement aging and thermosetting period.

SHERMAN D. LESESNE.

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