

Filed Feb. 24, 1959

METHOD FOR BONDING YARN ENDS

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This diagram shows the lower section of the device, including the base and internal components. Key features include:

- Base Assembly:** The bottom-most part, labeled **1**, which houses the internal mechanism.
- Internal Components:** Various parts are labeled with numbers such as **6**, **10**, **12**, **16'**, **18**, **20**, **21**, **23**, **24**, **25**, **31**, **37**, **37a**, **36'**, **36**, **47**, **49**, **48**, **65**, **16**, **43**, **44**, and **8'**.
- Mechanical Details:** The diagram illustrates the arrangement of springs, levers, and other mechanical elements within the base.
- Section Line II-II:** Indicated by arrows at the top and bottom of the diagram, showing the plane for Fig. 2.

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FIG. 2

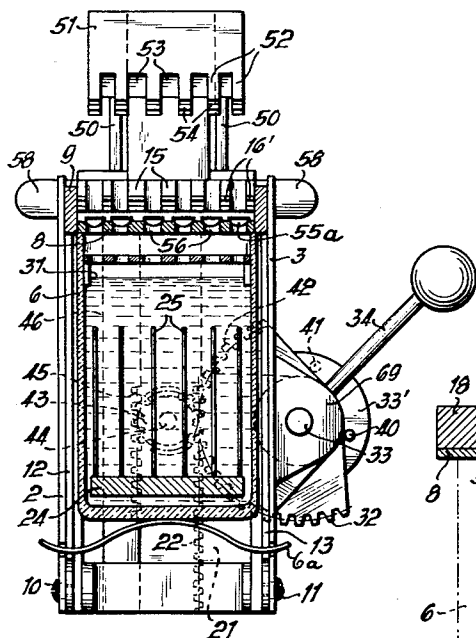


FIG. 4

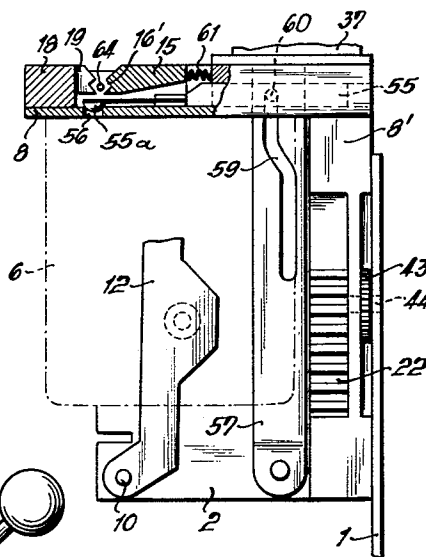
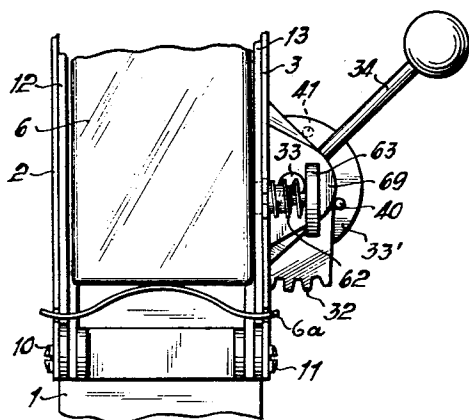


FIG. 5



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METHOD FOR BONDING YARN ENDS

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The present invention relates to a process for adhesively bonding yarn ends. The apparatus may be used as an attachment on yarn working machines, such as knitting or weaving machines and the like.

In carpet weaving, for instance, it has been known to bond together the ends of the coarse carpet yarns by applying an adhesive thereto. In this process, the yarn ends are first combed and then twisted together. The temporarily connected yarn ends are then placed on a support and adhesive is applied thereto.

Ends of lower denier yarns have been connected merely by twisting them together but this connection obviously is not resistant to tear. Therefore, these twisted connections have been produced immediately before the yarn was woven or knitted, right at the machine. In all other instances, the yarn ends were simply knotted together but the resultant knots caused difficulties on the knitting or weaving machines provided with automatic stops sensitive to knots in the yarn.

It is the principal object of the present invention to provide a process and means for adhesively bonding yarn ends of low denier yarns. The resultant bonds are so strong and flexible that the bonded portions are hardly distinguished from the remainder of the yarn.

Other objects and advantages of this invention will become apparent from the following description of preferred embodiments thereof.

In accordance with the process of the invention, a solution of a thermoplastic adhesive is applied at spaced spots of temporarily connected yarn ends and sufficient heat is applied to said spots to evaporate the solvent and to melt the adhesive, the adhesive setting after removal of the heat. The yarn ends may be combed and twisted together for their temporary connection, as conventional.

Since the adhesive spots are spaced apart, the entire bonded yarn portion remains flexible, the interspaces forming tiny joint-like links, as it were. The preferred spacing between adhesive spots is about 5 mm. to 6 mm.

Preferably, the adhesive is a dilute solution of a thermoplastic synthetic resin which may contain a plasticizer. Thermoplastic adhesives per se are well known in the art, as are plasticizers therefor.

A preferred adhesive is a solution of polyvinylacetate of a medium degree of polymerization, for instance, 20–90, in a hydrocarbon chloride solvent, such as methylene chloride, or a solvent mixture. If the adhesive is to be applied to yarns of higher denier and is required to have a higher strength, it is preferred not to use plasticizers in the solution. But for use with very fine yarns, plasticizers should be added, which will make the adhesive spots in the bonded yarn ends barely visible and almost impossible to detect by touch.

Other suitable synthetic resins useful for the adhesive solutions include low polyamides, such as Ultramid IC and Ultramid 6A, polyvinyl alcohols, for instance, Vinarol D.T., and polyacrylonitrile and polyacrylonitrile-butadiene copolymers.

A preferred plasticizer for use with hydrocarbon chloride solvents is cyclohexanol. If ketone solvents, such as acetone, are used, cyclohexanone may be used as a plasticizer.

Other suitable plasticizers include Palatinol C, tetra-

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chloro ethylene, ethylene chlorohydrin, Hostapal CV, and castor oil.

Favorable drying conditions are achieved if a solvent mixture of solvents with a low, medium and high boiling point is used, for instance, methylene chloride diluted with di- and tri-ethylene chloride. The mixed solvents must belong to related series.

The above process may be efficiently and automatically effectuated with the apparatus of this invention, which comprises clamping means actuatable to hold temporarily connected yarn ends in position and a plurality of pin-like adhesive applicators movable into contact with the yarn ends. The adhesive applicators are preferably immovable in an adhesive container and are reciprocally movable out of the container through spaces in the clamping means into contact with the yarn ends and back into the container. The apparatus also comprises a reciprocating heating means movable into proximity or contact with the yarn ends through the clamping means spaces.

The above and other features of the invention will be more fully explained in the following description of a preferred embodiment of the apparatus, taken in conjunction with the drawing wherein

FIG. 1 is a median vertical section of the bonding apparatus;

FIG. 2 is a section along line II—II of FIG. 1;

FIG. 3 is an enlarged side view of an adhesive applicator;

FIG. 4 is partly a side view and partly a section of the apparatus, similar to FIG. 1 but eliminating from view parts shown in FIG. 1 so as to make other parts visible; and

FIG. 5 is a partial front view of the apparatus.

Referring now to the drawing, an apparatus for bonding yarn ends is illustrated as a structural unit mounted on a support bracket 1. The support bracket may have rollers (not shown) guided in a rail to move the bracket with the bonding apparatus to different positions along a yarn working machine, such as a knitting or weaving machine.

The unit for bonding together yarn ends comprises a container 6 filled with an adhesive solution up to level 31. Container 6 rests on spring blade support 6a whose ends are mounted in slots in side walls 2 and 3, as shown in FIGS. 2 and 5. Back plate 8' is mounted between side walls 2 and 3 and is attached in any suitable manner to bracket support 1. The back plate forms an angle piece with substantially horizontal container cover 8. The cover carries a substantially U-shaped member whose two parallel legs form guide rails 9 along two side edges of the cover. As shown in FIGS. 1 and 4, the lateral portion 18 of the U-shaped member carries a plurality of notched clamping jaws 19. Arms 12 and 13 are fixed at their upper ends to slide 14 carrying yarn clamping jaws 15 having notches 16'. The support arms are pivotally mounted on side walls 2, 3 by means of bolts 10 and 11. Cooperating clamping jaws 15 and 19 are schematically shown. For instance, if the jaws 19 are spaced apart similarly to the spacing of jaws 15, as illustrated in FIG. 2, the jaws 19 may be so slotted that the jaws 15 engage the slots of jaws 19 with protruding portions thereof when they are moved toward jaws 19, as hereinbelow more fully explained.

Back plate 8' has guides for a vertically reciprocable slide 21 provided with rack 22. Slide 21 carries support arm 23 extending downwardly into container 6. A platform 24 is mounted at the inward end of support arm 23 and carries at its outer end a row of adhesive applicators 25.

As shown in FIG. 1, slide 21 is biased downwardly by compression spring 36. The lower portion of the com-

pression spring is seated in a vertical bore 20 in the slide while its upper portion is mounted about pin 36' which is connected to cap 37 whose top serves as a shoulder for the compression spring. Cap 37 is mounted on container cover 8 by means of bolt 37a, one end of which threadedly engages the cover while the cap is threadedly mounted on its other end. Since the adhesive container 6 is pressed tightly against the cover by spring blade 6a and cap 37 is placed over that portion of the cover which has the bore for support arm 23, no volatile solvent can escape from the container.

The adhesive applicators 25 are fully shown in FIG. 3. In the illustrated embodiment, they consist of a folded-over flat wire forming two like convex spring blades 26, 27 meeting at apex 28. The convex blades meet near their ends whence they are bent outwardly to constitute free ends 29, 30, forming a fork. As shown in FIG. 1, the adhesive applicators are totally immersed in adhesive in the rest position of the apparatus, adhesive level 31 being considerably above the ends of the applicators.

Vertical reciprocation of slide 21, producing concomitant movement of the adhesive applicators, is effected by the following means:

A pinion sector 32 engages the rack 22 of slide 21, the pinion being pivoted about axle 33. The pinion axle is mounted on lug 69 which may be fixed to side wall 3 or to support bracket 1. Entrainer disk 33' is freely rotatable about axle 33 and carries handle 34. Entrainer pins 40 and 41 are mounted on disk 33'. As shown in FIG. 2, when lever or handle 34 is pressed downwardly, i.e., moved clockwise, the pinion sector 32 is entrained by pin 40. This causes the slide 21 to be moved upwardly from the position indicated in FIGS. 1 and 2, against the bias of spring 36.

Handle 34 also serves to actuate an adhesive heating device provided in accordance with this invention and which will now be described. A heating element 51 of any suitable structure and carrying, for instance, electrical heating wires (not shown) is mounted at the forward end of a lever 50 pivoted at 50' on side wall 2. The heating element has a plurality of like fingers 52 provided with notches 54, fingers 52 being separated by spaces 53, as clearly shown in FIG. 2.

When the handle 34 is turned in a counter-clockwise direction, entrainer pin 41 engages and moves a second pinion sector 42 which is also mounted pivotally about axle 33 (and is partially covered in FIG. 2 by pinion sector 32). Pinion sector 42 engages and drives intermediate pinion 43 pivoted on pin 44. Pinion 43 engages rack 45 of slide 46. The upper end of slide 46 carries a transverse member with pins 47 engaging the slots 48 of bifurcated ends 49 of a plurality of arms of lever 50. As shown in FIG. 1, return springs 65 are mounted on respective lugs on the support bracket and on the transverse member of slide 46 to hold the slide and lever 50 in the position indicated in FIG. 1.

Cover 8 has a row of orifices 56 which permit the adhesive applicators 25, which are aligned with the orifices, to pass therethrough with their adhesive-carrying ends. Closure 55 is slidably mounted on the cover so that the orifices may be opened and closed.

Slide 21, which carries the adhesive applicators 25, carries lateral webs 57 which are provided with cam slots 59, as shown in FIG. 4. Pins 60, protruding from closure 55, engage the cam slots so that the closure will be automatically moved away from orifices 56 when slide 21 and applicators 25 are moved upwardly while the closure will be moved back over the orifices when slide 21 is moved downwardly into the illustrated position. As shown, the closure 55 carries a plurality of individual stoppers 55a fitting over orifices 56.

Finally, the yarn ends 64 may be clamped between jaws 15 and 19 by the following mechanism:

Slide 14 is mounted on cover 8 between guide rails 9 and carries at its forward end horizontally reciprocable jaws 15. The jaws are biased forwardly toward jaws

19 by compression springs 61, this forward movement being actuated by pressing button 63 (see FIG. 5). The button is outwardly biased by spring 62 and its inward end has a shoulder engaging a recess in arm 13. When button 63 is pressed, its shoulder is disengaged from the recess in arm 13, whereby springs 61 become free to move the jaws 15 forwardly into contact with jaws 19. The jaws 15 may be manually returned to the position shown in FIGS. 1 and 4 by gripping fixed buttons 58 (see FIG. 2) and pushing the jaws back until the shoulder of button 63 again engages the recess in arm 13, thereby holding the jaws 15 in position.

The adhesive applicator hereinabove described operates in the following manner:

Two combed yarn ends are first lightly twisted together to obtain a temporary connection therebetween, as is known. The connected yarn ends 64 are then manually placed between clamping jaws 15 and 19. Thereupon, button 63 is pressed to release arm 13 so that jaws 15 may be pressed by the action of spring 61 against jaws 19. In this manner the twisted yarn ends are clamped tight in a position for applying adhesive thereto. As is clearly shown in FIG. 2, interspaces between the jaws 15 leave interrupted portions of the yarn free for adhesive to be applied thereto.

After the yarn is clamped tight, handle 34 is pressed down to produce an upward movement of slide 21 and, with it, of adhesive applicators 25 which, emerging from the adhesive bath, are wetted with adhesive. Also moving with slide 21 are the attached webs 57 with their cam slots 59. The cam slots are so designed that follower pin 60, which moves in the slot, forces closure 55 to the right (as seen in FIGS. 1 and 4), thereby removing the stoppers 55a from orifices 56 in cover 8, just as the upper ends of the adhesive applicators approach the orifices. As the applicators move further upwardly through the orifices, their bifurcated ends 29, 30 seize the free portions of the clamped yarn ends so that these ends have dots of adhesive applied thereto. The applicators are narrower than orifices 56 so that neither the cover nor the clamping jaws are wetted with adhesive. A stop (not shown) is provided to delimit the downward movement of handle 34 so that it stops when the applicator ends contact the yarn ends. The handle is now released and, under the action of spring 36, the slide 21 returns to its original position (shown in the drawing), the applicators being immersed again in the adhesive bath to be wetted for the next operating cycle. Closure 55 automatically returns stoppers 55a to orifices 56 to close off the container and prevent evaporation of any volatile solvents contained therein.

After the yarn ends are thus wetted with adhesive, handle 34 is moved upwardly from the position shown in FIG. 2 and thus moves slide 46 upwards. This causes the lever arm 50 to be pivoted into a horizontal position about pivot 50' so that the heating element 51 with notched heaters 52 is moved into proximity or contact with the yarn ends through the interspaces 15. This causes any volatile solvent to evaporate and the thermoplastic adhesive to melt and to flow through the yarn. After a moment or so, handle 34 is released again and return springs 65 automatically move all parts back into the position illustrated in the drawing. The thermoplastic resin adhesive quickly sets after the heating element is removed. Fixed buttons 58 are now gripped and the jaws 15 are moved back out of clamping engagement with jaws 19. On moving back slide 14 by means of buttons 58, release arm 13 is also returned into its original position. One shoulder of button 63 is then engaged into the recess of arm 13 and, thus, holds said arm in said position. The firmly bonded yarn ends may now be removed and the adhesive applicator is in position for another operation.

It will be obvious to the skilled in the art that the composition of the adhesive solutions useful for the

process of the present invention may vary widely in respect of the basic components as well as component ratios. For instance, useful solvents include the following:

Solvent:	Boiling point, ° C.
Various esters-----	35-160
Chlorinated hydrocarbons-----	40-90
Acetone -----	56
Ethylene acetate-----	77
Methanol -----	65
Butyl acetate-----	117
Water -----	100

It may be preferred to prepare an adhesive stock solution, for instance, of polyvinylacetate dissolved in a solvent in the ratio of 2:1, and then, if desired, to dilute this stock solution in accordance with individual requirements, depending on yarn types and yarn denier. The diluent is one of the solvents or a mixture thereof, the diluted solution containing from about 15% to about 45% of the stock solution and, correspondingly, from about 85% to about 55% of the diluting solvent or solvent mixture. As stated hereinabove, a plasticizer is usually added to the solution.

A concentration of about 30% of the synthetic resin in the solution has proven to be effective in many instances.

That heat applied to the adhesive spots will depend primarily on the synthetic resin used in the adhesive solution, as well as on the boiling point of the solvent or solvents and the desired drying time. Accordingly, with the indicated compositions, the operating temperature will vary anywhere between about 70° C. and 320° C.

While it is thus evident that a great variety of adhesive compositions may be used in the practice of this invention, the following examples will illustrate certain useful compositions without in any way limiting the invention thereto.

Example 1

An adhesive solution is produced from a mixture of 16 cc. of polyvinylacetate 70 and 5 cc. of polyvinylacetate 20, a mixture of methylene chloride, dichloro ethylene, and trichloro ethylene in equal portions being used as the solvent. Useful adhesive solutions are produced with contents of 20%, 30%, and 40%, by weight, of the polymers in the solvent mixture.

Example 2

Polyvinylacetate 30 is substituted for the resin mixture of Example 1, 2% cyclohexanol being added as a plasticizer. Useful results are obtained when the amount of the plasticizer was increased up to 15%, by weight.

Example 3

An adhesive solution is produced from 30 g. of Ultramid 1C, 20 cc. of methanol, 10 cc. of water, 1 cc. of perchloro ethylene, and 70 cc. of trichloro ethylene. The content of perchloro ethylene can be raised up to 8 cc. with useful results,

Example 4

An adhesive solution is produced from 20 g. of polyvinyl alcohol D.T. and 50 g. of water.

Example 5

An adhesive solution is produced from 20 g. of polyvinylbutyral Bl. 18, 120 cc. of ethyl alcohol, and 8 g. of Hostapal CV.

It will be obvious that many variations and modifications of the described process and apparatus may occur to the skilled in the art, particularly after benefiting from the present teaching, without departing from the spirit and scope of the invention as defined in the appended claims. More particularly, while a preferred apparatus for carrying out the process has been disclosed and I am not aware of the usefulness of this apparatus for any materially different process, the process could also be manually operated.

I claim:

1. A process of bonding together two yarn ends which have been combed and twisted to produce a temporary connection, said process comprising the steps of applying to spaced spots of the temporarily connected yarn ends a solution of a potentially adhesive synthetic resin, applying sufficient heat to the spaced spots to evaporate the solvent from the solution and to melt the resin, and permitting the melted adhesive resin to cool whereby it will set at said spots.

2. The process of claim 1, wherein the adhesive resin is a thermoplastic synthetic resin.

3. The process of claim 1, wherein the adhesive resin solution contains a plasticizer.

4. A process of bonding together two yarn ends which have been combed and twisted to produce a temporary connection, said process comprising the steps of applying to spaced spots of the temporarily connected yarn ends a dilute solution of a potentially adhesive synthetic resin in a mixture of related solvents of low, medium, and high boiling point, applying sufficient heat to the spaced spots to evaporate the solvents and to melt the resin, and permitting the melted adhesive resin to cool whereby it will be set at said spots.

5. The process of claim 4, wherein the resin is polyvinylacetate of a medium degree of polymerization and the solvent mixture consists of methylene chloride diluted with dichloro ethylene and trichloro ethylene.

6. The process of claim 5, wherein the solution contains cyclohexanol as a plasticizer.

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