

Sept. 11, 1973

L. R. WITHEROW
METHOD AND APPARATUS FOR SPLICING WEBS OF PHOTOGRAPHIC
FILM OR PAPER
Filed Sept. 23, 1971

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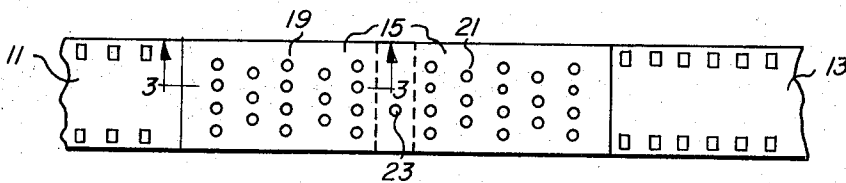


FIG. 1

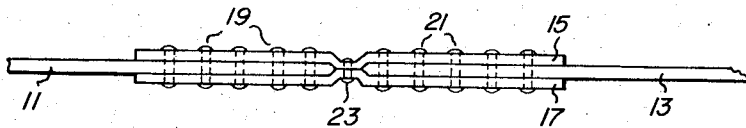


FIG. 2

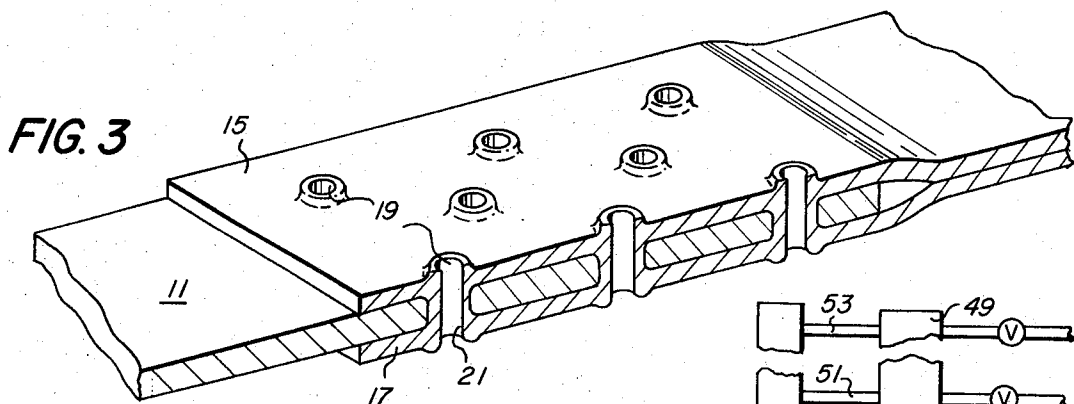


FIG. 3

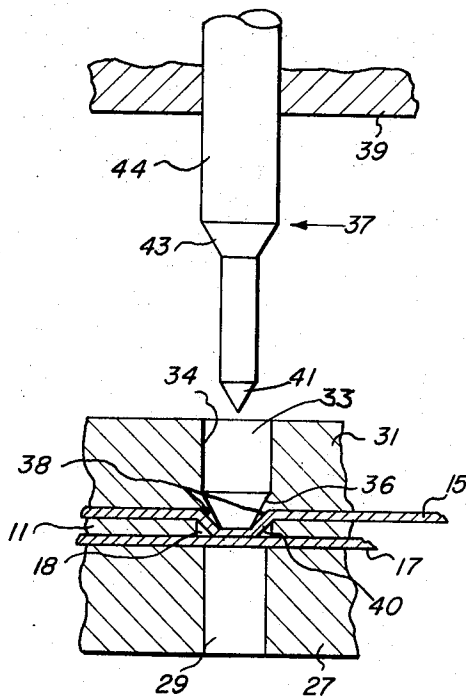


FIG. 4

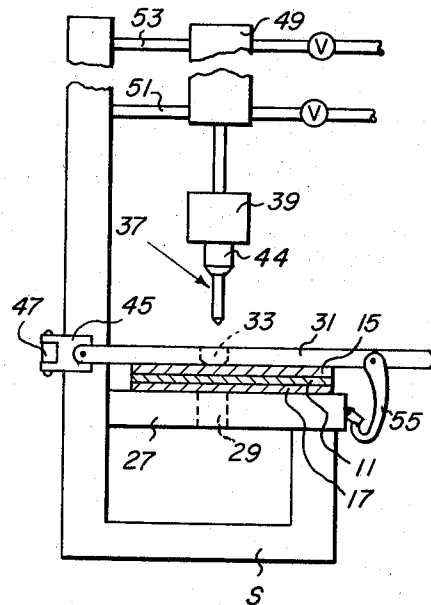


FIG. 5

LAWRENCE R. WITHEROW
INVENTOR.

BY *Henry M. Chapin*

ATTORNEY

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METHOD AND APPARATUS FOR SPLICING WEBS OF PHOTOGRAPHIC FILM OR PAPER

Lawrence R. Witherow, Rochester, N.Y., assignor to Eastman Kodak Company, Rochester, N.Y.

Filed Sept. 23, 1971, Ser. No. 183,001

Int. Cl. B31f 5/00; B32b 3/10; G03d 15/04

U.S. Cl. 156—157

8 Claims

ABSTRACT OF THE DISCLOSURE

A method for splicing together first and second webs in end-to-end relationship comprising the steps of (a) providing at least one hole through each web; (b) juxtaposing said webs end-to-end; (c) positioning two splicing patches comprising thermoplastic material on opposite surfaces of said webs and overlying end portions of both webs and said holes therein; (d) passing through both of said patches and each of said holes a hot pin to soften and merge together in each hole softened plastic from said patches. A plurality of joiners can be preformed in this way simultaneously. A joiner can also be provided in the space between the ends of the webs. The initial holes in the webs can be pierced by the hot pin prior to splicing. The apparatus for performing the method includes a first plate having a first hole therein adapted to support the webs and patches, a second plate having a second hole therein aligned with the first hole, a pin movable axially through the two holes, and means for heating the pin. The second plate has an annular boss on the periphery of its hole to force the patch into the second hole slightly before penetration by the heated pin. The two spliced webs as an article of manufacture are also within the invention.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to the splicing together of two webs of material, such as photographic film or paper. The invention contemplates an improved method and apparatus, and an improved article of manufacture comprising spliced webs.

The prior art

In the past it has been the practice to splice together long webs of photographic film or paper with metal eyelets or staples, or with patches carrying pressure sensitive or heat sensitive adhesives. The principal need for such splicing is in the processing of numerous individual lengths of photographic film or paper, which are spliced together end-to-end and passed as an endless belt through successive processing solutions. Eyelets and staples sometimes cause physical damage to the web and to the processing equipment, and also may contaminate the processing solutions. Pressure sensitive and heat sensitive adhesives sometimes do not adhere as tightly as necessary to a variety of surfaces, and may not retain their adherence under conditions of photographic processing. The failure of only one splice in an endless belt of photographic film or paper may cause the ruin of numerous individual film lengths, as well as delaying the processing operation while repairs are made. Consequently, it has been the aim of engineers operating in this art to devise splicing techniques which will be 100% effective, so as to avoid the above mentioned problems.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a novel method for splicing together two webs in end-to-end relationship by the steps of:

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- (a) providing at least one hole through each web;
- (b) juxtaposing the webs end-to-end;
- (c) positioning two imperforate splicing patches comprising thermoplastic material on opposite surfaces of the webs, and overlying end portions of both webs and the holes therein; and
- (d) passing through both of the patches and each of the holes a hot pin to soften or melt and merge together in each hole softened plastic from the two patches, forming in effect a hollow rivet in each hole.

The technique advantageously is applied to the simultaneous formation of a plurality of such rivets by providing a plurality of such holes punches through each web, and simultaneously passing a plurality of hot pins on a single carrier through the patches and all of the holes.

The resulting article of manufacture comprises the two joined webs having the splicing patches of thermoplastic material on their opposite surfaces, and integral bonds between the two patches extending through the axially aligned holes in the patches and the webs.

The novel apparatus for performing the method and producing the article of manufacture comprises a base plate having one or more holes therein, a top plate having corresponding holes aligned axially with those in the base plate, one or more pins movable axially through the aligned holes, and suitable means for heating the pins so as to soften or melt the material of the plastic patches.

THE DRAWING

In the drawing:

FIG. 1 is a plan view showing two webs of motion picture film spliced together by the method of the invention;

FIG. 2 is a side elevational view of the spliced films of FIG. 1;

FIG. 3 is a perspective view on a greatly enlarged scale of one-half of the spliced film, with part shown in section, as taken along the line 3—3 in FIG. 1;

FIG. 4 is a vertical sectional view, partly in side elevation, showing on a greatly enlarged scale the apparatus for producing the splice of FIGS. 1—3; and

FIG. 5 is a schematic side elevational view, with more detail, of the apparatus of FIG. 4.

THE PREFERRED EMBODIMENTS

Referring to FIGS. 1—3, the spliced webs produced in accordance with the invention comprise a first web 11, such as a motion picture film of a cellulose ester or a poly(ethylene terephthalate) plastic, and a similar web 13, both of which are joined together in end-to-end longitudinally spaced relationship by a top splicing patch 15 and a bottom splicing patch 17. Patches 15 and 17 can be all thermoplastic resin; or can comprise thermoplastic resin which is bonded to a paper layer suitable for carrying identifying indicia such as numbers on the outside of the splice.

A plurality of integrally formed hollow eyelets 19 and 21 extend through the two patches and the webs, with each eyelet being lined with a hollow plastic rivet which has been integrally formed from the patches by the melting and merging together of plastic within the eyelet, as shown at 21 in FIG. 3. Additionally, the ends of the two webs 11 and 13 may be abutted together, or may be spaced slightly from one another, and the portions of patches 15 and 17 which bridge the gap between can be united, if desired, by one or more eyelets 23 which also comprise integrally merged softened plastic from the two patches. Eyelets 23 can be performed so that the two patches can be handled as a unit and slipped over the ends of the two webs.

The method for producing the novel splice described in detail above will become apparent from FIG. 4. For simplicity this description will extend only to the formation of a single eyelet, which is exemplary of the numerous eyelets actually required for a strong splice. An imperforate bottom splicing patch 17 is positioned on a base plate 27 having a first cylindrical hole 29 therein. The two webs 11 and 13 having preformed holes 18 therein are juxtaposed with their ends spaced slightly apart on top of the patch 17, the second imperforate patch 15 is laid on top of the webs so as to bridge the gap between the ends, and then a top pressure plate 31 having a second hole 33 therein is positioned on top of patch 15 with its hole in axial alignment with the hole 29. The wall of hole 33 has a cylindrical top portion 34 and a frusto conical bottom portion or second shoulder 36; and there is an annular boss 38 on the perimeter which presses the top patch down into hole 18 slightly.

A pin 37 carried by a plunger 39, and heated to a temperature substantially above the softening or melting point of the plastic of patches 15 and 17, then is passed down through hole 33 and penetrates through the depressed part of patch 15, passes through hole 18 in the web, penetrates patch 17, and enters the second hole 29. The material of the patches is melted into contact with one another and, due to the heat of the pin, the plastic merges together and unites to form an integral bond within hole 18.

In order to assist penetration by pin 37, its lower end is pointed as shown at 41. The pin 37 includes a bevelled first shoulder 43 which flares outwardly and upwardly to a portion 44 of the same diameter as hole 18. Shoulder 43 abuts against the wall on second shoulder 36 at the bottom of hole 33 to stop penetration.

The pressure from the top plate 31 assures that the patches will be uniformly and tightly brought into contact with the webs being spliced, and that the plastic of the two patches will fuse together within hole 18.

Pin 37 can be heated in any desired way (not shown) as by an internal electrical resistance heater or a high frequency electrical induction heater, or even by a gas fired flame. An electrically heated soldering iron has been used manually for individual holes. The pin temperature advantageously is between 750 and 850° F. for rapid operation.

The material of patches 15 and 17 can be any of the well known thermoplastic resins such as polyethylene, polypropylene, vinyl chloride, a copolymer of vinyl chloride and vinyl acetate, poly(ethylene terephthalate) and the like. Selection of the appropriate patch material depends upon the conditions to which the splice is to be subjected after completion. For example, when photographic film or paper is to be processed by passing it through a number of chemical solutions, it is necessary to select a suitable patch material which will not disintegrate in those solutions.

Webs 11 and 13 can be perforated in any desired way before the splicing operation, as by mechanically punching or thermally melting holes therein. The latter can be accomplished by the upper large portion 44 of heated pin 37 before the patches and pressure plate 31 are applied.

FIG. 5 shows a simple apparatus for performing the splicing operation. A stand S carries horizontal base plate 27, and a top plate 31 which is pivotally mounted for movement in a vertical plane on a block 45 which in turn is pivotally mounted for movement in a horizontal plane on a hinge 47. Pin 37 is moved up or down by a pneumatic or hydraulic piston within a cylinder 49 which is mounted on support S by brackets 51 and 53.

When the hole 18 is to be pierced by pin 37 before splicing, a latch 55 is disengaged and plate 31 is swung to one side on hinge 47. Then web 11 is placed on base plate 27 and heated pin 37 is driven down and then up to pierce the hole by a combination of mechanical and

thermal action. Then the patches 15 and 17 are positioned, pressure plate 31 is moved back into position on top of the sandwich and latched tightly in place, after which heated pin 37 is again driven down to unite the two patches as described previously.

Numerous splices have been made and tested in accordance with this invention and have been found to be extremely strong and dependable, and to resist the effects of photographic process solutions.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. A method for splicing together first and second webs in end-to-end relationship comprising the steps of:

- (a) providing at least one hole through each web;
- (b) juxtaposing said webs end-to-end;
- (c) positioning two splicing patches comprising thermoplastic material on opposite surfaces of said webs and overlying end portions of both webs and said holes therein;
- (d) passing through both of said patches and each of said holes a hot pin to soften and merge together in each hole softened plastic from said patches.

2. A method in accordance with claim 1, comprising punching a plurality of said holes through each web, and simultaneously passing a plurality of hot pins through said patches and all of said holes.

3. A method in accordance with claim 1 wherein said webs are juxtaposed with the ends thereof spaced from one another, and wherein said patches bridge the space between said ends, said method also comprising fusing said patches together in said space.

4. A method in accordance with claim 1 wherein said hot pin has a smaller diameter than said holes, said method also comprising depressing a first one of said patches into each hole and passing said hot pin first through said first one of said patches.

5. A method in accordance with claim 1 wherein said first and second webs are photographic film or photographic paper.

6. Apparatus for splicing webs comprising:

- a first plate having a first hole therein;
- a second plate having a second hole therein aligned axially with said first hole;
- a pin movable axially through said first and second holes; and
- means for heating said pin.

7. Apparatus in accordance with claim 6 wherein said pin comprises an end portion of smaller diameter than said first and second holes, and a bevelled first shoulder flaring to a portion of greater diameter, and wherein said second hole has a second shoulder therein adapted to engage said first shoulder to limit movement of said pin.

8. Apparatus in accordance with claim 6 wherein said second plate has an annular boss on the periphery of said second hole on the side of said plate adapted to engage a splicing patch for forcing said patch into said second hole before penetration by said pin.

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PHILIP DIER, Primary Examiner

U.S. Cl. X.R.

156—252, 304, 505, 513; 161—38, 112, 145