

1 TWO-STAGE LAMINATOR APPARATUS

2 Background and Summary of the Invention:

3 The instant invention relates to laminator apparatus
4 for laminating thermoplastic sheets together, and more
5 particularly to laminator apparatus including face-to-
6 face, endless belts for transporting thermoplastic sheets
7 through successive pre-laminating, laminating and cooling
8 stations.

9 Belt-type laminator apparatus of the general type
10 contemplated herein, have heretofore been known in the
11 art. In general, the prior art laminators typically
12 include only a single heating station for applying heat
13 to the surfaces of the thermoplastic sheets while
14 maintaining the sheets in face-to-face relation. While
15 these single-stage laminators have been effective for
16 many types of thermoplastic sheet materials, there are
17 certain types of thermoplastic sheet materials, such as
18 those materials used in making identification or security
19 cards, which have specific heating and cooling
20 characteristics which are not met by the prior art
21 devices.

22 The instant invention provides a two-stage laminator
23 apparatus comprising upper and lower belt assemblies
24 which are supported in closely spaced adjacent relation.
25 The lower belt assembly comprises a stainless steel belt
26 received around first and second rollers, and the upper

1 belt assembly comprises a teflon impregnated, fiberglass
2 belt received around third and fourth rollers. The belt
3 assemblies are supported in a frame structure such that
4 the first and third rollers form an input nip, and the
5 second and fourth rollers form an output nip, with the
6 endless belts in facing relation. The first and second
7 rollers are fixed in position, with the third and fourth
8 rollers being slidably suspended relative to the first
9 and second rollers. The third and fourth rollers are
10 biased downwardly from their suspended position toward
11 the first and second rollers to form spaced, but
12 pressurized input and output nips. The first, or lower,
13 input roller is heated by an internal cartridge heater
14 to a temperature of about 200°C. The heated input nip
15 thus defines an initial laminating stage. A heating
16 platen, positioned in abutting relation with an upper
17 portion of the metallic belt adjacent to the first roller
18 is heated to a temperature of about 160°C to define a
19 full laminating stage. Fan cooled heat sinks are
20 positioned in abutting relation adjacent to the output
21 nip for cooling the metallic and fiberglass belts passing
22 therebetween.

23 In particular, the instant apparatus is useful for
24 laminating a security card system comprising an amorphous
25 copolyester backing sheet, a polyvinyl chloride (PVC)
26 cover sheet, and a security image positioned between the

1 sheets. The security image is preferably reverse printed
2 via conventional thermal dye transfer technology onto the
3 underside of the cover sheet so that the security image
4 is securely located between the sheets where it cannot be
5 tampered with. When viewed through the upper surface of
6 the cover sheet, the reverse printed image appears in its
7 correct orientation. The amorphous copolyester and PVC
8 sheets are compatible polymers which effectively fuse
9 together under heat and pressure without the use of an
10 intermediate adhesive. In use, the rotating belts are
11 operative for transporting the overlapping cover and
12 backing sheets between the input nip and the output nip.
13 The overlying sheets are inserted into the input nip of
14 the apparatus with the cover sheet facing downwardly,
15 wherein the cover sheet is initially laminated to the
16 upper backing sheet under the heat and pressure of the
17 input nip rollers. After the initial lamination, passage
18 over the adjacent heated platen further heats the pre-
19 laminated sheets while in a fixed position, wherein the
20 sheets are able to fully fuse or laminate together. The
21 fused, laminated sheets are thereafter cooled by passage
22 between the fan-cooled heat sinks.

23 Accordingly, among the objects of the instant
24 invention are the provision of a two-stage laminating
25 device wherein two thermoplastic sheets are pre-laminated
26 under heat and pressure, fully laminated under heat

1 alone, and then cooled; the provision of a laminating
2 device including facing endless belts for transporting
3 sheet materials through a pre-lamination station, a full
4 laminating station, and a cooling station; and the
5 provision of a laminating device including a heated input
6 nip, a heated platen and fan cooled heat sinks.

7 Other objects, features and advantages of the
8 invention shall become apparat as the description thereof
9 proceeds when considered in connection with the
10 accompanying illustrative drawings.

11

12 **Description of the Drawings:**

13 In the drawings which illustrate the best mode
14 presently contemplated for carrying out the present
15 invention:

16 Fig. 1 is a front view of the laminator apparatus of
17 the instant invention;

18 Fig. 2 is a rear view thereof;

19 Fig. 3 is a top view thereof; and

20 Fig. 4 is a cross-sectional view thereof taken along
21 line 4-4 of Fig. 3.

22

23 **Description of the Preferred Embodiment:**

24 Referring now to the drawings, the laminator
25 apparatus of the instant invention is illustrated and
26 generally indicated at 10 in Figs. 1-4. As will

1 hereinafter be more fully described, the instant
2 laminator apparatus 10 is operative for laminating face-
3 to-face thermoplastic sheet materials, such as those
4 types of sheet materials used in constructing security
5 cards. More specifically, the instant invention 10 has
6 been found to be particularly useful in fusing a security
7 card system developed by Minnesota Mining and
8 Manufacturing Company of Saint Paul Minnesota, and
9 described in U.S. Patent Application No. 08/128,484 which
10 is incorporated herein by reference.

11 The subject security card system generally indicated
12 at 12 in Fig. 4, comprises a backing sheet 14, a cover
13 sheet 16, and a security image (not shown), with the
14 security image preferably being reverse printed on the
15 inner surface 18 of the cover sheet 16 so that it is
16 located between the laminated sheets 14, 16 when secured
17 together. When viewed through the upper side of the
18 cover sheet, the reverse printed security image appears
19 in its correct orientation. The backing and cover sheets
20 14, 16 are laminated in direct contact together without
21 an intermediate layer of adhesive, wherein the backing
22 sheet 14 preferably comprises an amorphous copolyester
23 film, and the cover sheet 16 comprises a rigid polyvinyl
24 chloride film. The amorphous copolyester backing sheet
25 14 is preferably pigmented with titanium dioxide so that
26 it is opaque white, while the PVC cover sheet 16 is

1 preferably transparent, although other color schemes and
2 arrangements are also suitable. In most instances, the
3 backing sheet 14 is considerably thicker than the cover
4 sheet as it is intended to provide most of the rigidity
5 and strength of the assembled card 12. For example, the
6 backing sheet 14 preferably has a thickness of between
7 about 20 and 22 mils, and the cover sheet 16 preferably
8 has a thickness of between about 7 and 10 mils for a
9 total card thickness of between about 27 and 32 mils.
10 The particular advantage of the subject security card
11 system 12 is that good adhesion can be achieved between
12 PVC and amorphous copolyesters at relatively low
13 temperatures, e.g., at temperatures of about 150°C. The
14 adhesion can be effectively achieved because both
15 amorphous copolyesters and PVC are softened during the
16 lamination process, and both contract on cooling at about
17 the same rate, thereby reducing warping problems
18 encountered with other existing card materials.

19 The instant laminator apparatus 10 comprises upper
20 and lower belt assemblies generally indicated at 20 and
21 22, which are supported in closely spaced adjacent
22 relation by a frame assembly comprising a bottom wall 24,
23 and parallel front and rear walls, 26 and 28
24 respectively.

25 The lower belt assembly 22 comprises a stainless
26 steel belt generally indicated at 30 received around

1 first and second metallic rollers 32, 34 respectively,
2 and the upper belt assembly 20 comprises a teflon
3 impregnated, fiberglass belt generally indicated at 36
4 received around third and fourth metallic rollers, 38 and
5 40 respectively. Both the stainless steel belt 30 and
6 the fiberglass belt 36 preferably have thicknesses of
7 about .003 inches. The steel belt 30 is commercially
8 available from Belt Technologies of Agawam, MA, and the
9 fiberglass belt 36 is available from Greenbelt
10 Industries, Inc. of Buffalo, NY. The rollers 32, 34, 38,
11 40 preferably comprise aluminum rollers having shafts
12 32S, 34S, 38S, 40S. It is pointed out that shafts 32S
13 and 38S are hollow, while shafts 34S and 40S are solid.

14 The belt assemblies 20, 22 are supported in the
15 frame such that the first and third rollers 32, 38 form
16 an input nip, and the second and fourth rollers 34, 40
17 form an output nip, with the endless belts 30, 36 in
18 facing relation. The first and second rollers 32, 34 are
19 fixed in position, with the third and fourth rollers 38,
20 40 being slidably movable relative to the first and
21 second rollers 32, 34. More specifically, the shaft of
22 each roller is received through a pair of spaced bearing
23 mounts generally indicated at 42A, 42B, 42C, and 42D.
24 Each bearing mount 42 comprises a bearing 44A, 44B, 44C,
25 44D which is supported in a bearing holder 46. Bearings
26 44A and 44C each comprise a roller-type bearing, while

1 bearings 44B and 44D comprise sleeve-type bearings.
2 Furthermore, the sleeve bearings 44B and 44D are mounted
3 in a hardened outer sleeve 45. Each bearing holder 46
4 includes a recess 48 for receiving the bearing 44
5 therein, and further includes grooves 50 in the side
6 edges thereof. The grooves 50 of the bearing mounts 42
7 are slidably received in respective slots 52 in the front
8 and rear walls 26, 28 of the frame assembly so that the
9 bearing holder 46 engages both the inner and outer
10 surfaces of the walls 26, 28. The bearing mounts 42A and
11 42B rest against the bottom of their respective slots 52,
12 and thus maintain the first and second rollers 32, 34 in
13 a fixed vertical position. It is pointed out that the
14 recesses 48B in the bearing mounts 42B (second roller 34)
15 are elongated in a horizontal direction to allow sliding
16 horizontal movement of the axis of the second roller 34
17 with respect to the first roller 32. In this connection,
18 a set 54 is extended through a threaded opening in the
19 side wall of the bearing mount 46B and engaged with the
20 hardened outer sleeve 45 to adjust the distance between
21 the axis of the first roller 32 and the axis of the
22 second roller 34. This set screw arrangement is
23 operative for adjusting the parallelism of the first and
24 second roller axes as well as for taking up or tightening
25 slack in the steel belt 30. The bearing mounts 42D for
26 the fourth roller 40 have the same elongated recess 48D

1 and set screw 54 for adjustment of the fourth roller axis
2 with respect to the third roller axis.

3 The bearing mounts 42C, 42D for the third and fourth
4 rollers 38, 40 are suspended in the frame assembly by
5 screws 56 which extend downwardly through spaced
6 suspension bars 58 attached to the front and rear walls
7 26, 28. The head 60 of the screw 56 rests on top of the
8 bar while the shaft 62 passes through an opening (not
9 shown) in the bar 58 and extends into a threaded bore (no
10 shown) in the top of the respective bearing holder 46.
11 A compression spring 64 is received around each screw 56
12 and captured between the top of the respective bearing
13 holder 46 and the bottom of the respective suspension bar
14 58 to bias the third and fourth rollers 38, 40 downwardly
15 from their suspended position toward the first and second
16 rollers 32, 34. Rotation of the screw 56 permits
17 adjustment of the vertical spacing between the third and
18 first rollers 38, 32 (input nip rollers) and the fourth
19 and second rollers 40, 34 (output nip rollers). In this
20 regard, the belt assemblies 20, 22 are adjusted so that
21 there is at 25 mil spacing between the input rollers 32,
22 38 and between the output rollers 34, 40, the spacing
23 being slightly smaller than the combined thickness of the
24 security card sheets (27-33 mils). Since the third and
25 fourth rollers 38, 40 are biased downwardly toward the

1 first and second roller 32, 34, the roller pairs form
2 spaced, but pressurized input and output nips.

3 The first, or lower, input roller 32 is heated by a
4 conventional cartridge heater 66 to a temperature of
5 between about 190°C and about 215°C, but more preferably
6 to a temperature of about 200°C. The cartridge heater 66
7 is slidably received in the center of the hollow roller
8 shaft 32S and is energized by a conventional electric
9 source (not shown). The input nip (rollers 32, 38) thus
10 defines an initial or pre-laminating stage for fusing the
11 cover and backing sheets 14, 16 together under pressure
12 and heat.

13 Referring now to Fig. 4, a full laminating stage is
14 defined by a 1/2 inch thick aluminum heating platen 68,
15 positioned in abutting relation with an upper portion of
16 the steel belt 30 adjacent to the first roller 32. The
17 platen 68 is preferably heated to a temperature between
18 about 150°C and about 170°C, and more preferably to a
19 temperature of about 160°C. Heating of the platen 68 is
20 accomplished by means of a rubber plate heater 70 glued
21 to the bottom surface of the platen 68. A rubber plate
22 heater 70 of the type contemplated is available from
23 Hotset, Inc. of Battle Creek, MI. Alternatively, other
24 heating devices, such as cartridge-type heaters, could be
25 used to heat the platen 68.

1 In order to cool the belts 30, 36 and the laminated
2 sheets 14, 16 held therebetween, first and second fan
3 cooled heat sinks generally indicated at 72, 74
4 respectfully, are positioned in abutting relation
5 adjacent to the output nip (rollers 34, 40). More
6 specifically, a first aluminum heat sink 72 is positioned
7 between the front and rear walls 26, 28 of the frame,
8 with the body portion 72B in abutting relation with the
9 upper portion of the steel belt 30. Fasteners 76 extend
10 through the front and rear walls 26, 28 of the frame and
11 into openings (not shown) in the heat sink 72 to fixedly
12 secure the heat sink 72 in position. A second heat sink
13 74 is positioned between the front and rear walls 26, 28
14 of the frame assembly with the body portion thereof 74B
15 in abutting relation with the lower portion of the
16 fiberglass belt 36. A second set of fasteners 78 extend
17 through vertical slots 80 in the frame walls 26, 28 and
18 into the second heat sink 74. Springs 82 are secured
19 between the fastener pairs to draw the second movable
20 heat sink 74 downwardly into compressing relationship
21 with the first fixed heat sink 72. The fins 72F, 74F of
22 the heat sinks 72, 74 extend perpendicular to the
23 direction of travel of the belts 30, 36 wherein first and
24 second fans 82, 84 mounted to the rear wall of the frame
25 respectively blow air over the fin surfaces 72F, 74F in
26 a direction perpendicular to the direction of belt

1 travel. To facilitate rapid air movement and optimize
2 cooling, the air is moved through openings 86, 88 in the
3 front and rear walls 26, 28 of the frame assembly.

4 In use, the belts 30, 36 are rotated simultaneously
5 in opposite directions for transporting the overlapping
6 cover and backing sheets 14, 16 between the endless belts
7 from the input nip to the output nip. Rotation of the
8 belts 30, 36 is accomplished via an electric motor
9 generally indicated at 90 and gear system. The body 92
10 of the electric motor 90 is mounted to a bracket 94
11 attached to the rear wall 28 of the frame assembly. The
12 drive shaft 96 of the motor 90 includes a worm gear
13 portion 98 for rotating a drive gear 100 mounted on the
14 rear end of the shaft 34S of the second roller 34 (Fig.
15 2, 3). Rotation of the lower belt assembly 22 is
16 transferred to the upper belt assembly 20 by a pair of
17 intermeshing transfer gears 102, 104 mounted on the front
18 ends of the shaft 34S, 40S of the second and fourth
19 rollers 34, 40 (Fig. 1). The motor 90 and gear assembly
20 are preferably timed for transporting cards through the
21 apparatus at a rate of about 0.25 inches per second. The
22 instant device is thus operative for transporting a
23 conventional size ID card through the laminator at a rate
24 of about 1 card per minute.

25 The apparatus 10 further includes upper and lower
26 steering assemblies generally indicated at 106 and 108

1 for maintaining proper alignment and rotation of the
2 belts 30, 36 on their respective rollers. Each steering
3 assembly 106, 108 comprises a shaft 110 mounted between
4 the front and rear walls 26, 28 of the frame. The shaft
5 110U of the upper steering assembly 108 extends
6 immediately beneath the upper portion of the fiberglass
7 belt 36 adjacent the input nip, and the shaft 110L of the
8 lower steering assembly extends immediately above the
9 lower portion of the steel belt 30 adjacent to the input
10 nip (Fig. 4). Mounted on each of the shafts 110 is a
11 mating pair of truncated cone rollers 112 with the larger
12 diameter ends of the roller 112 facing toward the outer
13 ends of the shafts 110. In this regard, as the belts 30,
14 36 rotate, if either belt should skew toward one side or
15 the other, the belt will ride upwardly on the
16 corresponding truncated roller 112, wherein it will be
17 urged back downwardly into its normal rotating position.

18 The apparatus 10 is intended to be used with the
19 cover sheet 16 of the card system facing downwardly and
20 the backing sheet facing 14 upwardly. As the overlying
21 sheets 14, 16 are fed into the input nip, the backing and
22 cover sheets 14, 16 are pressed together under the
23 pressure of the nip while the cover and backing sheets
24 14, 16 are heated by the heated lower roller 32 of the
25 input nip. The pressure of the input nip squeezes out
26 air bubbles from between the sheets 14, 16 prior to

1 laminating, and further maintains the cover and backing
2 sheets 14, 16 in proper registration during initial
3 heating by the roller 32. Maintaining the sheets 14, 16
4 in proper registration during the initial heating is
5 extremely important, since the plastic materials become
6 somewhat soft, and movement of the sheets at their
7 interface while in a molten state will cause smudging or
8 smearing of the security image printed on the inner side
9 18 of the cover sheet 16. After the initial lamination,
10 the pre-laminated sheets 14, 16 are transported over the
11 heated platen 68 which further heats the sheets for a
12 longer duration while in a fixed position wherein they
13 are able to fully fuse or laminate together. It is noted
14 that the longer exposure to heat over the platen 68
15 significantly softens the upper backing sheet 14 to a
16 point wherein the surface grain or texture of the
17 fiberglass belt 36 can be unwantedly imprinted on the
18 back surface 114 of the backing sheet 14. In this
19 connection, a lower portion of the fiberglass belt 36
20 directly above the heating platen 68 is cooled by a fan
21 116. The air directed across the fiberglass belt 36
22 keeps the back surface 114 of the backing card 14
23 sufficiently cool and rigid so as not to be imprinted
24 with the surface texture of the fiberglass belt 36.

25 The laminated sheets 14, 16 are thereafter cooled to
26 almost room temperature by passage between the fan-cooled

1 heat sinks 72, 74. The sinks 72, 74 effectively remove
2 almost all of the heat from the sheets 14, 16 prior to
3 exiting from the apparatus between the output nip.

4 It can therefore be seen that the instant invention
5 provides an effective laminating apparatus 10 which is
6 effective for pre-laminating a pair of sheet materials
7 under pressure and heat, further heating the pre-
8 laminated sheets to achieve a full bond, and then cooling
9 the laminated sheets prior to exiting the apparatus. The
10 apparatus achieves these objectives by providing a
11 pressurized input nip having a heated roller 32. Sheet
12 materials passed through the input nip are laminated
13 under the pressure and heat of the nip. The pre-
14 laminated materials are then passed over a heated platen
15 68 for further heating of the sheets materials to achieve
16 a full bonding of the materials. The fully laminated
17 sheets are then cooled by fan cooled heat sinks 72, 74
18 prior to passage out of the apparatus through a
19 pressurized output nip. For these reasons, the instant
20 invention is believed to represent a significant
21 advancement in the art which has substantial commercial
22 merit.

23 While there is shown and described herein certain
24 specific structure embodying the invention, it will be
25 manifest to those skilled in the art that various
26 modifications and rearrangements of the parts may be made

1 without departing from the spirit and scope of the
2 underlying inventive concept and that the same is not
3 limited to the particular forms herein shown and
4 described except insofar as indicated by the scope of the
5 appended claims.



REPLACED SHEETS SG

- ☐ Description : paged to paged
☒ Claim(s) : paged ...17... to paged ...35...
☐ Drawing(s) : paged to paged
☐ Abstract : paged to paged

Claims:

- 1 1. A laminator apparatus for fusing face-to-face sheet
2 materials comprising:
3 means for pressing said sheets together while
4 maintaining said sheets in fixed registration to remove
5 air bubbles from between said sheets;
6 means for heating said sheets to a first temperature
7 while said sheets are being pressed together in fixed
8 registration, wherein said sheets are pre-laminated;
9 means for heating said pre-laminated sheets while
10 maintaining said sheets in fixed registration wherein
11 said sheets become fully heat fused together; and
12 means for cooling said sheets.
- 1 2. A laminator apparatus for laminating face-to-face
2 sheet materials comprising:
3 an input nip having upper and lower rollers;
4 means for heating one of said upper and lower
5 rollers;
6 a heated platen adjacent to said input nip;
7 means for advancing said sheet materials from said
8 input nip to said heating platen;
9 cooling means adjacent to said heated platen; and
10 means for advancing said sheet materials from said
11 heated platen to said cooling means.





- 1 3. A laminator apparatus comprising:
- 2 a first belt assembly including a first endless belt
- 3 received around first and second rollers;
- 4 a second belt assembly including a second endless
- 5 belt received around third and fourth rollers;
- 6 means for supporting said first and second belt
- 7 assemblies in closely spaced adjacent relation wherein
- 8 said first and third rollers form an input nip, said
- 9 second and fourth rollers form an output nip, and said
- 10 first and second endless belts are in facing relation;
- 11 means for rotating said first and second belt
- 12 assemblies for transporting sheet materials between said
- 13 first and second endless belts from said input nip to
- 14 said output nip;
- 15 means for heating said first roller wherein said
- 16 sheet materials are initially laminated together under
- 17 heat and pressure of said input nip;
- 18 means for heating an upper portion of said first
- 19 endless belt adjacent to said first roller wherein said
- 20 sheet materials are fully laminated together; and
- 21 means adjacent said output nip for cooling said
- 22 first and second endless belts said sheet materials are
- 23 cooled before exiting through said output nip.





1 4. In the laminator of claim 3, said first roller being
2 heated to a temperature between about 190 C and about
3 215 C.

1 5. In the laminator apparatus of claim 4, said means
2 for heating said first roller comprising a cartridge
3 heater inserted in a bore extending through said roller.

1 6. In the laminator apparatus of claim 3, said upper
2 portion of said first endless belt adjacent to said first
3 roller being heated to a temperature between about 150 C
4 and about 170 C.

1 7. In the laminator apparatus of claim 6, said means
2 for heating said upper portion of said first endless belt
3 comprising a metallic platen positioned in abutting
4 relation with an upper portion of said first endless belt
5 adjacent to said first roller; and

6 means for heating said platen to said second
7 predetermined temperature.

1 8. The laminator apparatus of claim 3 further
2 comprising means for cooling a lower portion of said
3 second endless belt adjacent to said third roller.





1 9. In the laminator apparatus of claim 8, said means
2 for cooling said lower portion of second endless belt
3 adjacent said third roller comprising a fan directing an
4 airflow perpendicular to a direction of travel of said
5 endless belts.

1 10. In the laminator apparatus of claim 3, said means
2 for cooling said endless belts adjacent to said output
3 nip comprising a first heat sink positioned in abutting
4 relation with the upper portion of said first endless
5 belt and a second heat sink positioned in abutting
6 relation with the lower portion of said second endless
7 belt.

1 11. In the laminator apparatus of claim 10, said heat
2 sinks having fins which extend perpendicular to a
3 direction of travel of said endless belts, said cooling
4 means further comprising first and second fans for
5 directing air across a respective heat sink in a
6 direction perpendicular to a direction of travel of said
7 endless belt.

1 12. In the laminator apparatus of claim 3, said first
2 endless belt comprising a metallic belt, and said second
3 endless belt comprising a fiberglass belt.



1 13. In the laminator apparatus of claim 3, said first,
2 second, third and fourth drums being mounted for rotation
3 about respective parallel axes, said laminator apparatus
4 further comprising means for adjusting a longitudinal
5 distance between said axes of said first and second
6 drums, and between said third and fourth drums.

1 14. In the laminator apparatus of claim 3, said first,
2 second, third and fourth rollers being mounted for
3 rotation about respective parallel axes, said laminator
4 apparatus further comprising means for adjusting a
5 distance between said axes of said first and third drums,
6 and between said second and fourth drums.

1 15. The laminator apparatus of claim 3 further
2 comprising first and second steering means for
3 maintaining proper alignment of respective first and
4 second endless belts on said rollers during rotation
5 thereof.

1 16. A laminator apparatus comprising:
2 a lower belt assembly including a metallic endless
3 belt received around first and second rollers, said first
4 roller comprising a metallic roller;





5 an upper belt assembly including a teflon
6 impregnated, fiberglass endless belt received around
7 third and fourth rollers;

8 means for supporting said upper and lower belt
9 assemblies in closely spaced adjacent relation wherein
10 said first and third rollers form an input nip, said
11 second and fourth rollers form an output nip, and said
12 endless belts are in facing relation;

13 means for rotating said first and second belt
14 assemblies for transporting sheet materials between said
15 endless belts from said input nip to said output nip;

16 means for biasing said third roller downwardly
17 toward said first roller;

18 means for heating said first roller wherein said
19 sheet materials are initially laminated together under
20 heat and pressure of said input nip;

21 a heating platen positioned in abutting relation
22 with an upper portion of said metallic belt adjacent to
23 said first roller;

24 means for heating said platen wherein said sheet
25 materials are fully laminated together;

26 means for cooling a lower portion of said fiberglass
27 belt adjacent to said third roller;

28 means adjacent said output nip for cooling said
29 metallic and said fiberglass endless belts wherein said



30 sheet materials are cooled before exiting through said
31 output nip.

1 17. In the laminator of claim 16, said first roller
2 being heated to a temperature between about 190 C and
3 about 215 C.

1 18. In the laminator apparatus of claim 17, said means
2 for heating said first roller comprising a cartridge
3 heater inserted in a bore extending through said roller.

1 19. In the laminator apparatus of claim 16, said means
2 for cooling said second endless belt adjacent said third
3 roller comprising a fan directing an airflow
4 perpendicular to a direction of travel of said endless
5 belts.

1 20. In the laminator apparatus of claim 16, said platen
2 being heated to a temperature between about 150 C and
3 about 170 C.

1 21. In the laminator apparatus of claim 16, said means
2 for cooling said endless belts adjacent to said output
3 nip comprising a first heat sink positioned in abutting
4 relation with the upper portion of said first endless
5 belt and a second heat sink positioned in abutting





6 relation with the lower portion of said second endless
7 belt.

1 22. In the laminator apparatus of claim 21, said heat
2 sinks having fins which extend perpendicular to a
3 direction of travel of said endless belts, said cooling
4 means further comprising first and second fans for
5 directing air across a respective heat sink in a
6 direction perpendicular to a direction of travel of said
7 endless belts.

1 23. In the laminator apparatus of claim 16, said first,
2 second, third and fourth drums being mounted for rotation
3 about respective parallel axes, said laminator apparatus
4 further comprising means for adjusting a longitudinal
5 distance between said axes of said first and second
6 drums, and between said third and fourth drums.

1 24. In the laminator apparatus of claim 16, said first,
2 second, third and fourth rollers being mounted for
3 rotation about respective parallel axes, said laminator
4 apparatus further comprising means for adjusting a
5 distance between said axes of said first and third drums,
6 and between said second and fourth drums.





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1 25. The laminator apparatus of claim 16 further
2 comprising first and second steering means for
3 maintaining proper alignment of respective first and
4 second endless belts on said rollers during rotation
5 thereof.

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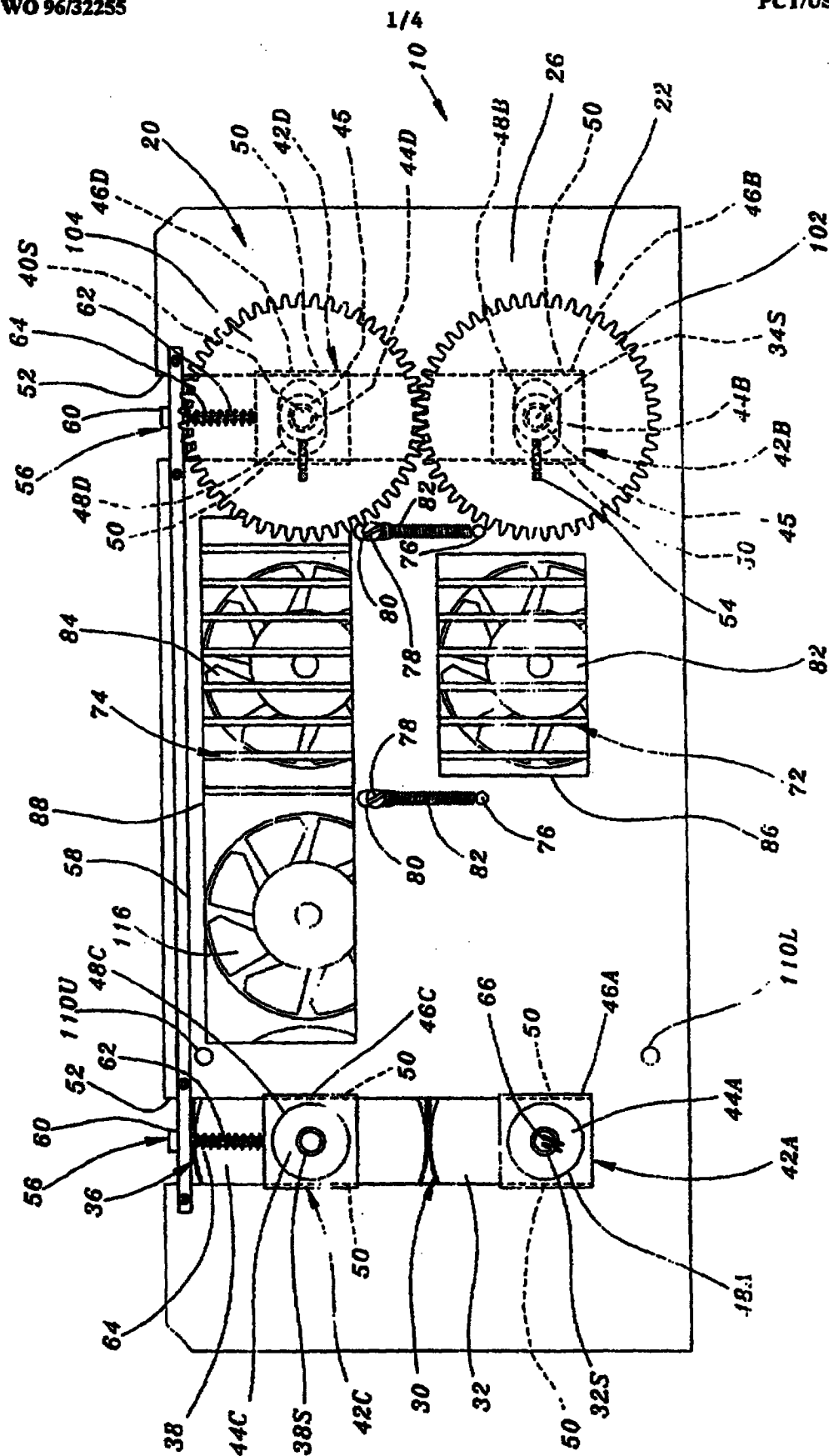


FIG. 1

2/4

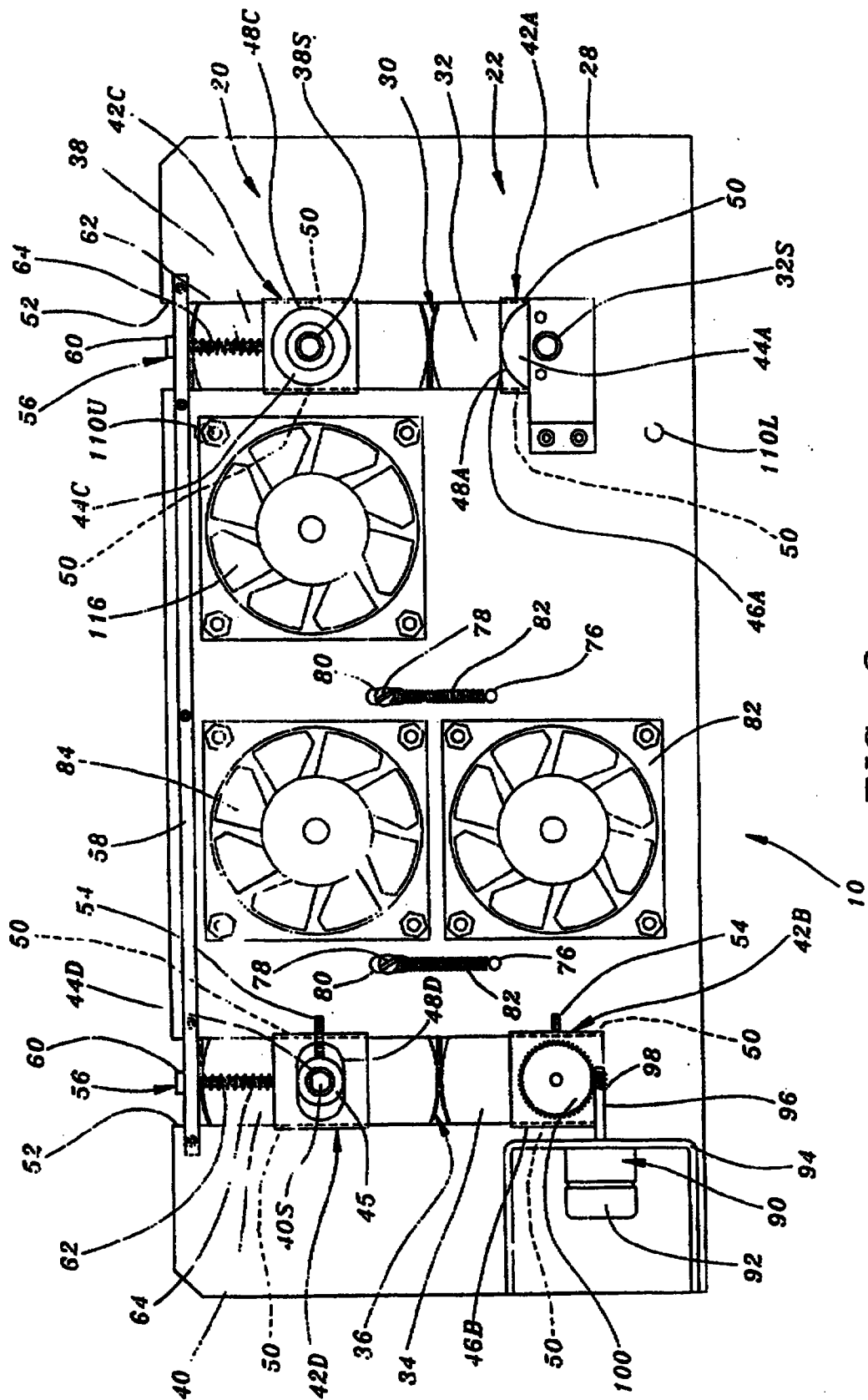


FIG. 2

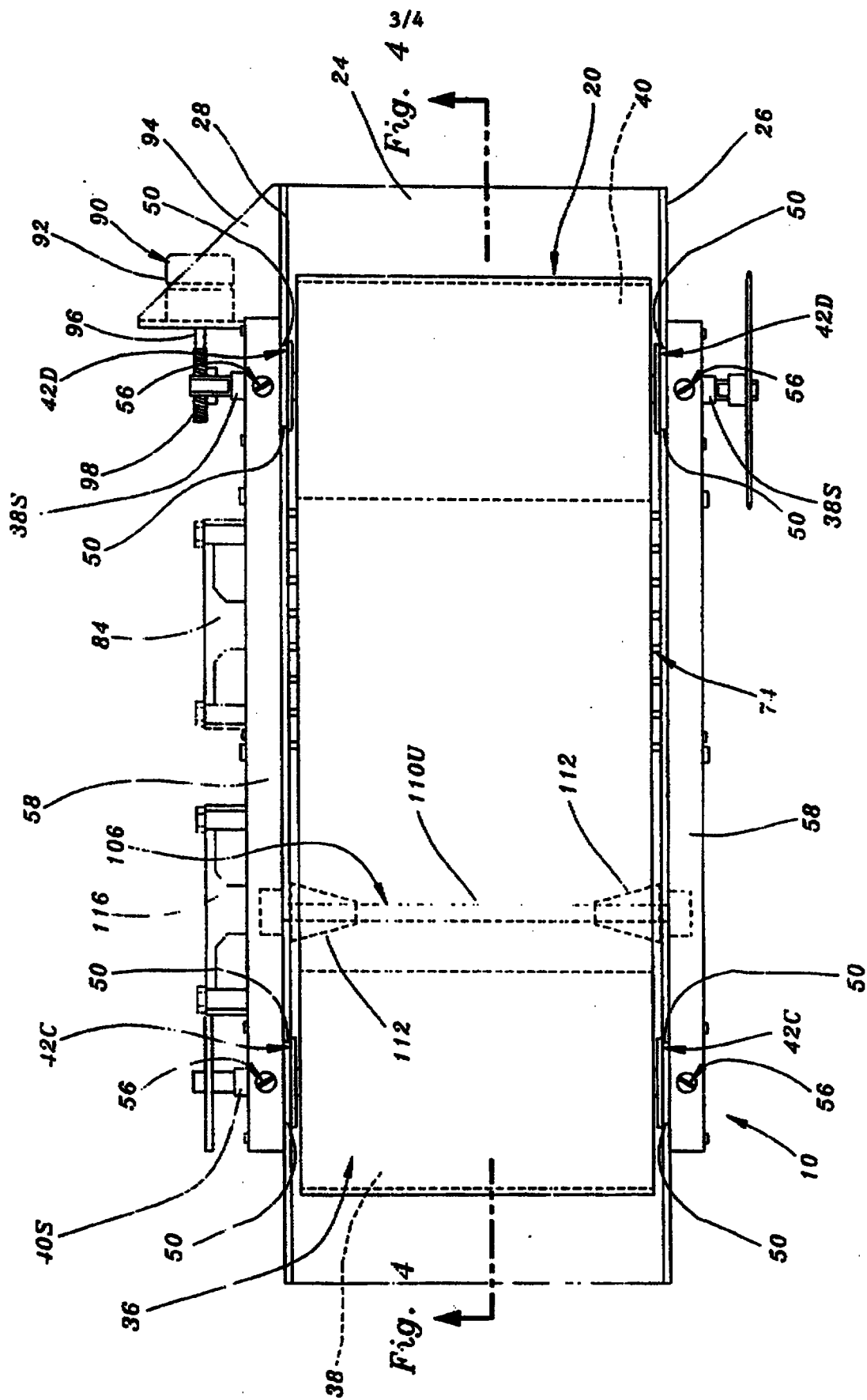


FIG. 3

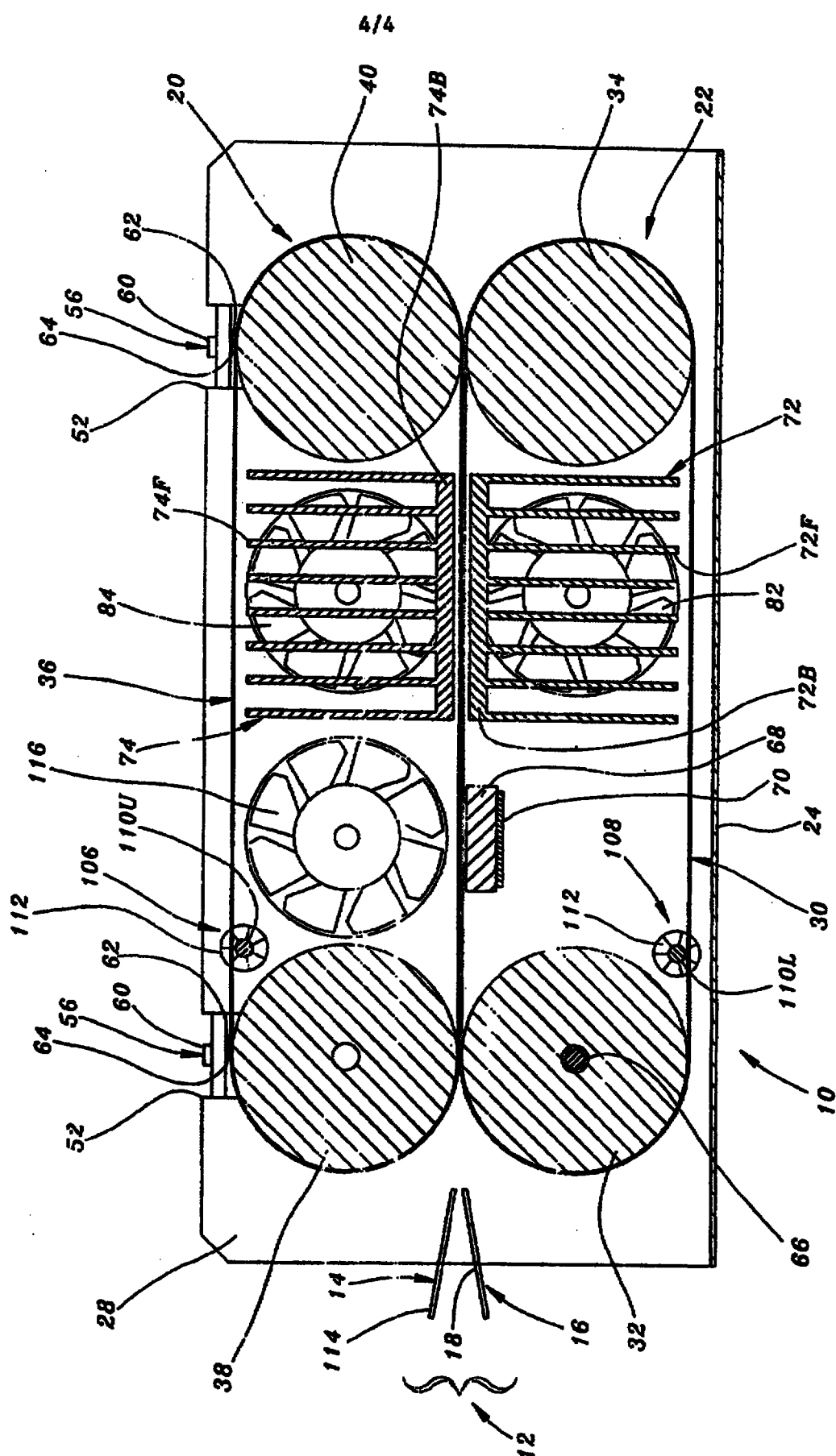


FIG. 4



CLAIMS

1. Apparatus (10) for fusing a first polymeric sheet (16) in face-to-face relation with a second polymeric sheet (14) comprising:

5 a first belt assembly (22) including a first endless belt (30) received around first and second rollers (32, 34);

a third roller (38) mounted in cooperation with said first roller (32) to form an input nip with said first roller (32), said first and third rollers pressing said sheets (14, 16) together in face-to-face relation to define a two-piece structure (12), said first polymeric sheet (16) being received
10 adjacent said first roller (32) and said second polymeric sheet (14) being received adjacent said third roller (38) while said sheets are being pressed together;

means (66) for heating only said first roller (32) such that only said first polymeric sheet (16) is heated, said pressure and said heat achieving
15 an initial fusing of said first and second polymeric sheets; and

heated platen means (68) for applying heat to said first polymeric sheet (16), said heated platen means being in thermal communication with an underside of said belt (30), said two piece structure (12) being supported on an upper side of said belt and being transported from said input nip over
20 the surface of said heated platen means wherein further heat is applied under ambient pressure to said first polymeric sheet.



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2. The apparatus of claim 1 further comprising cooling means (72, 74) downstream of said heated platen means (68) for cooling said sheets.

3. A method for fusing a first polymeric sheet (16) in face-to-face
5 relation with a second polymeric sheet (14), comprising the steps of:

arranging said first and second polymeric sheets (14, 16) in face-to-face relation to define a two-piece card structure (12);

applying pressure to said face-to-face sheets (14, 16) to press said sheets together;

10 preheating only the first polymeric sheet (16) while said sheets are
being pressed together, said pressure and heat achieving an initial fusing of
the sheets;

removing the applied pressure from the initially fused sheets; and
then

15 applying heat to only said first polymeric sheet (16) of the initially fused two-piece card structure (12) to achieve full fusion of the first and second polymeric sheets (14, 16) to each other.

4. The method of claim 3 further comprising the step of cooling said
20 fused sheets of said two-piece structure (12).



5. The method of claim 3 wherein said step of applying pressure to said face-to-face sheets (14, 16) comprises to step of pressing said sheets together in face-to-face relation in a nip roller structure (32, 38) to define a two-piece card structure (12) having a first side defined by said first
5 polymeric sheet and an opposing second side defined by said second polymeric sheet.

6. The method of claim 5 wherein said step of preheating comprises the step of heating said first side of said two-piece card structure (12) to a first
10 temperature while said card structure (12) is being pressed together in said nip roller structure (32, 38) such that said heat softens the first polymeric sheet (16) and further such that heat passes through said first polymeric sheet (16) to heat an inner surface of said second polymeric sheet (14), said heat and said nip pressure achieving an initial fusing of said first and second
15 polymeric sheets (14, 16) without any air bubbles being formed therebetween.

7. The method of claim 5 wherein said step of applying heat to only the first polymeric sheet (16) comprises the step of heating said first side of said two-piece structure (12) to a second temperature without deforming
20 said second polymeric sheet (14).



8. The method of claim 6 wherein said step of applying heat to only the first polymeric sheet (16) comprises the step of heating said first side of said two-piece structure (12) to a second temperature without deforming said second polymeric sheet (14).

5

9. The method of claim 4 wherein said step of cooling comprises the step of cooling the two-piece structure (12) to remove heat from said two-piece structure without deforming said second polymeric sheet (14).

10 10. A laminator apparatus for fusing face-to-face sheet materials comprising:

an input nip system (32, 38, 30, 36) through which the materials pass upon entry into the apparatus;

means (68) for heating the sheets while maintaining the sheets in
15 fixed registration wherein the sheets become fully fused together;

an output nip system (20, 34, 30, 36) through which the laminated materials exit the apparatus;

characterized in that

the input nip system (32, 38, 30, 36) is adapted to apply pressure to
20 said sheets and to preheat one sheet thereof whereby the sheet materials
can be prelaminated prior to lamination in the means for heating the sheets.

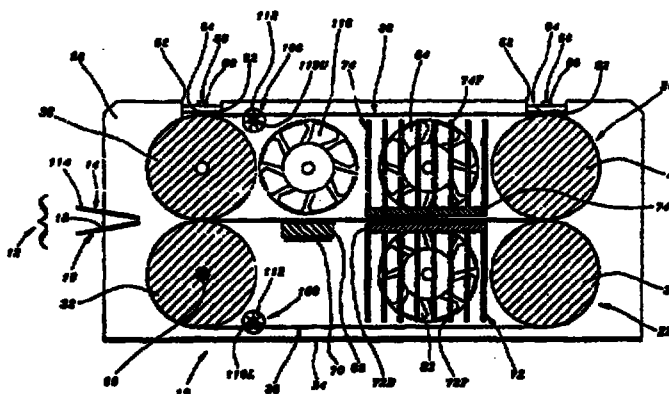
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(54) Title: TWO-STAGE LAMINATOR APPARATUS



(57) Abstract

A laminator apparatus (10) includes upper and lower belt assemblies (20, 22) which are supported in closely spaced adjacent relation. The lower belt assembly (22) includes a stainless steel belt (30) received around first and second metallic rollers (32, 34), and the upper belt assembly (20) includes a teflon impregnated, fiberglass belt (36) received around third and fourth metallic rollers (38, 40). The belt assemblies (20, 22) are positioned such that the first and third rollers (32, 38) form an input nip, and the second and fourth rollers (34, 40) form an output nip, with the endless belts (30, 36) positioned in facing relation. The first roller (32) is heated by an internal cartridge heater (66) to about 200 °C, and a heating platen (68), positioned in abutting relation with an upper portion of the metallic belt adjacent to the first roller, is heated to about 160 °C. Fan-cooled heat sinks (72, 74) are positioned in abutting relation adjacent to the output nip for cooling the metallic fiberglass belt passing therebetween. The belts are rotated for transporting thermoplastic sheet (14, 16) materials between the endless belts from the input nip to the output nip, wherein the lower thermoplastic sheet (16) is initially laminated to the upper thermoplastic sheet (14) under the heat and pressure of the input nip rollers (32, 38), and then fully laminated by passage over the heating platen (68). The laminated plastic sheets are thereafter cooled by passage between the fan-cooled heat sinks (72, 74).