(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 844 983 B9

(12) **CORRECTED EUROPEAN PATENT SPECIFICATION**
Note: Bibliography reflects the latest situation

(15) Correction information:
Corrected version no 1 (W1 B1)
Corrections, see page(s) 10

(48) Corrigendum issued on:
13.08.2003 Bulletin 2003/33

(45) Date of publication and mention of the grant of the patent:
02.01.2003 Bulletin 2003/01

(21) Application number: **96926881.2**

(22) Date of filing: **05.08.1996**

(51) Int Cl.[7]: **C03B 13/00**, C03B 15/00, C03B 17/00, C03B 19/00, C03B 21/00, C03B 23/00, C03B 23/02, C03B 25/00, C03B 27/00, C03B 29/00, C03B 23/03, C03B 35/16

(86) International application number:
PCT/US96/12696

(87) International publication number:
WO 97/007066 (27.02.1997 Gazette 1997/10)

(54) **GLASS SHEET CONVEYING AND BENDING APPARATUS**

VORRICHTUNG ZUM BIEGEN UND TRANSPORT VON GLASTAFELN

APPAREIL POUR DEFORMER ET TRANSPORTER DES PLAQUES DE VERRE

(84) Designated Contracting States:
BE DE ES FI FR GB IT LU SE

(30) Priority: **14.08.1995 US 514741**

(43) Date of publication of application:
03.06.1998 Bulletin 1998/23

(73) Proprietor: **LIBBEY-OWENS-FORD CO.**
Toledo, Ohio 43697-0799 (US)

(72) Inventors:
- **FLAUGHER, Jeffrey, R.**
Clarkston, MI 48348 (US)
- **SKILLITER, William, J.**
Genoa, OH 43430 (US)
- **DEW, Vince**
Toledo, OH 43612 (US)

(74) Representative: **Pfenning, Meinig & Partner GbR**
Joachimstaler Strasse 10-12
10719 Berlin (DE)

(56) References cited:
US-A- 3 338 695
US-A- 3 871 855
US-A- 4 872 898
US-A- 5 297 669
US-A- 5 320 661

EP 0 844 983 B9

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

[0001] Field of the Invention. The present invention pertains generally to an apparatus for the press bending of glass sheets, and more particularly, to a press bending apparatus provided with interchangeable subassemblies formed by a lower press member with interlocking conveyor. Arcuately shaped conveyor rolls are mounted within a continuous peripheral press bending ring such that the outer ends of the conveyor rolls are in close proximity to the press bending ring to support the heat-softened glass sheets.

[0002] Summary of Related Art. Glass sheet conveyor and bending apparatus are used in the mass production of curved or bend glass sheets for the automobile industry and other similar applications. In high volume production operations, sheets are generally advanced one after another along a horizontal path on roll-type conveyors through the production process. The specific operations in the production process include heating the glass to its softening point, bending the glass to the desired shape, and finally controlled cooling of the bent sheets of glass in order to anneal or temper the glass.

[0003] The glass sheets are heated to the softening point in passing through a heating furnace. The sheets are advanced by conveyor into a forming or bending area where the sheets are precisely shaped into the desired configuration. After shaping, the glass sheet is transferred to a cooling station where it is controllably cooled to temper or anneal the glass.

[0004] The primary processes used for shaping the heat-softened glass are roll forming, press bending, and gravity forming. In roll forming, the heated glass is conveyed on top of a series of shaping rolls, or between an upper set and lower set of shaping rolls which engage the glass for shaping. Press bending involves positioning the glass in the bending apparatus between complementary upper and lower shaping members. The properly oriented sheet is then engaged along its lower marginal edge portions by the lower press member and lifted from the conveyor rolls to be pressed to the precise predetermined curvature between the complementary shaping surfaces of the press members. In gravity forming, the heated glass is allowed to sag into conformity with a frame or series of contoured shaping rolls by the force of gravity.

[0005] To be suitable for automotive applications, the flat glass sheets must be shaped to precisely defined curvatures dictated by the shape and outline of the window openings in the vehicle. Another important requirement is that the windows meet stringent optical requirements and that the windows are free of optical defects and reflective distortion that could interfere with the view through the glass in the viewing area.

[0006] During the past several years, the automotive companies have been specifying the use of thinner glass sheets for automobile side windows as a means for reducing the overall weight of the vehicle. The thinner glass poses problems in shaping and tempering the glass due to heat retention differences and to the inability to achieve and maintain the desired shape of the glass after heating.

[0007] As the thickness of the glass decreases, the rate of heat loss increases and the heat initially imparted so the thin glass sheets is quickly dissipated upon leaving the heating atmosphere of the furnace and during the relatively cool shaping step. If the glass cools too quickly, the glass will not be sufficiently soft for expedient and proper bending, and the glass sheets will not retain the necessary heat for tempering. If the glass sheets are overheated to maintain the desired temperature, the glass sheets will be extremely pliable with attendant loss of deformation control and will tend to sag out of the desired shape beyond the close tolerances prescribed. Overheating tends to degrade the surface quality of the finished glass as a result of heat stains, roll distortion, roll marking, pitting, marginal edge sagging, and other related problems. In addition, automotive applications now require the bending of small, narrow rectangular and non-rectangular shaped glass.

[0008] In bending the glass sheets, a simple bend provides for the glass sheet to be bent along a single axis, which is generally transverse to the conveyor line. When a glass sheet is bent to a compound shape, the press forming apparatus must provide both a longitudinal and transverse axis of bending.

[0009] The glass industry needs improved glass bending apparatus which can process the thin glass in an efficient manner while minimizing degradation of the glass. One of the problems in bending glass is positioning and bending of the glass in the bending apparatus without distortion or sagging of the glass. After the glass is bent to the desired configuration, the glass must also be adequately supported as it is moved to the cooling step (anneal or temper) in the process.

[0010] Numerous patents have been issued regarding the process and equipment for roll forming glass, including patents disclosing the use of aligned pressure rolls in which a concave-shaped roll is paired with a convex-shaped roll. U.S. Patent Nos. 3,701,644; 3,856,499; 3,871,855; 3,891,420; 3,929,441; 3,934,996; 3,992,181; 4,043,783 (Frank); and 3,869,269 (Knapp) disclose roll forming apparatus capable of shaping a succession of discrete moving glass sheets to either simple or compound shapes involving uniform and non-uniform radii of curvature.

[0011] U.S. Patent No. 4,123,246 to Johnson et al. teaches shaping glass sheets by gradually transferring a succession of glass sheets from an obliquely disposed series of stationary, cylindrically shaped conveyor rolls onto alternately disposed, shaped, rotating stationary forming rolls.

[0012] U.S. Patent No. 4,218,232 to Wilhelm discloses the shaping of glass sheet by lifting the moving glass

sheets onto a first series of rotating shaping rolls moving transversely upward between adjacent stationary cylindrical conveyor rolls to provide rolling engagement against the lower surface of the glass for sufficient time to shape the glass. In this process, the upper surfaces of the glass are not touched during the shaping of the glass.

[0013] The press bending apparatus disclosed in the prior art have disclosed several configurations of mold forming members and conveyor rolls to position, bend, and convey the sheets of glass upon transfer from the furnace to the press bending apparatus. U.S. Patent No. 3,338,695 to Ritter discloses a continuous peripheral press bending ring with a series of support rolls disposed within the open ring outline of the lower mold. The open ring is disposed slightly below the outer periphery of the support rolls. The rolls support the heated sheet of glass in the horizontal plane before and after the glass is bent between the continuous ring of the lower mold and the upper mold. However, the rolls did not fully support the heated glass in the press bending apparatus.

[0014] To provide support for the glass sheets while the sheets are in the highly heated softened condition necessary for proper bending, U.S. Patent No. 3,905,794 to Revells et al. suggests the use of conveyor rolls of generally arcuate form, rotatable about their own axis. Each of the conveyor rolls comprises a non-rotatable inner core member and an outer sleeve mounted for rotation about and relative to the inner core member. The conveyor rolls support the heated glass sheet throughout its length before and after the sheet is bent. The rolls are disengagable from the glass sheet at the appropriate time to preclude frictional movement between the glass sheet and the conveyor rolls. The female shaping ring is formed by a plurality of segments including end bars.

[0015] U.S. Patent No. 4,047,919 discloses a press bending apparatus having a segmented lower shaping rail and with contoured rolls to convey the sheets of glass. In addition, the press bending apparatus discloses supplemental heating means in the press bending area. The conveyor rolls are concave in shape and complement the curvature of the heat softened bent glass sheets. The concave portion of each roll is designed to be shorter than the transverse dimension of the sheet of glass to avoid frictional engagement of the lateral side portions adjacent the wider leading edge.

[0016] U.S. Patent No. 4,670,036 teaches a continuous shaping ring with a plurality of rollers mounted on a support base. The rollers are located on both the inside and outside of the shaping ring to support the glass sheet. The heated glass sheets are received from the oven on contoured rolls and the sheets sag into conformity with the contoured rolls as the sheets are advanced into position for press bending.

[0017] A mobile press bending apparatus is described in U.S. Patent no. 4,872,898 to Enk et al. Rails are laid out transversely of the production line in the press bending area between the furnace and the cooling station for tempering. In order to minimize model changeover time, two or more press bending sections are used on the production line. When one press bending section is in use, a second press bending apparatus is set up off-line with the required conveyor rolls and bending members. When a model changeover is scheduled to take place, the first press section is removed from production and the second press section is positioned in line to minimize lost production time.

[0018] U.S. Patent No. 5,004,492 to Borer et al. teaches a another form of a press bending section with a continuous peripheral shaping rail mounted for vertical reciprocating movement. In the press bending section, the conveyor rolls are modified to provide stub rolls on the outside of the shaping rail and independent auxiliary rolls mounted inside the shaping rail.

[0019] A different mold configuration is disclosed in U.S. Patent No. 5,286,271 to Rueter et al. A continuous ring forms the lower section of the mold and lifts the glass from a conveyor to engage the upper vacuum mold. Once the glass sheet is formed, the continuous ring is lowered and the glass sheet is retained against the upper mold by a vacuum. The upper mold is moved by overhead rails to deposit the formed glass sheet on the adjacent conveyor for further processing.

[0020] U.S. Patent No. 5,292,356 discloses an apparatus for press bending glass sheets to a relative deep curvature. The upper press mold member is mounted on a special structure to facilitate reciprocal movement of the press mold member. A subplate is adapted for carrying a variety of press members.

[0021] Another recent press bending apparatus having rollers for processing glass sheet with reverse bend curvatures is disclosed in U.S. Patent Number 5,297,669 to Neuendorf. The rolls in the press bending apparatus have a U-shaped portion at each end of the rolls to provide for a continuous shaping rail. One of the problems with the rolls with U-shaped ends is providing adequate support to the heated glass sheet around the peripheral edges of the glass in order to prevent sagging of the glass.

[0022] None of the patents disclose a continuous peripheral press bending ring in combination with a plurality of concave rollers positioned inside the ring. Additional improvements to the tooling configuration and the construction of the press bending apparatus are desired to improve production efficiency and the quality of the glass produced in the press bending operations.

SUMMARY OF THE INVENTION

[0023] It is the object of the present invention to provide an improved roll conveyor system and press bending ring configuration to minimize sagging and degradation in the formed glass.

[0024] This object according to the invention is solved by an apparatus for press bending heat-softened glass

sheets comprising the features of claim 1. Preferred embodiments of the apparatus according to the invention are defined in the subclaims.

[0025] The invention refers to an apparatus for press bending heat-softened glass sheets comprising a frame;
a bending mold mounted on said frame for bending sheets of glass, said bending mold including a lower generally horizontally disposed press member having a continuous peripheral shaping rail conforming to a marginal outline of the sheet of glass and an upper horizontally disposed press member opposed to the lower press member, the two press members having complemental shaping surfaces, drive means mounted on said frame for selectively raising and lowering the lower press member to position the shaping rail in a lowered position for receiving a first sheet of glass, in a raised position for shaping the first sheet of glass, and in the lowered position for transferring the first sheet of glass after it is bent and then receiving a second sheet of glass;
a conveyor mounted on said frame for moving the sheets of glass along a predetermined, generally horizontal path from a heating end of said frame into and through a bending area wherein said lower press member is raised from said lowered position to said raised position, said conveyor including, in the bending area, a plurality of rotatably mounted, parallel, horizontal shafts extending transversely across the path below the shaping rail of the lower press member; and
a plurality of conveyor rolls.

[0026] According to the invention, this apparatus is characterized in that each conveyor roll is longitudinally, rotatably secured on one of the horizontal shafts such that the conveyor rolls are disposed within the marginal outline of said shaping rail, said conveyor rolls having opposing end portions extending radially from the shafts and positioned in close proximity to opposing sides of the shaping rail, said conveyor rolls having a circular cross section with a progressively diminishing diameter from the end portions to provide a generally concave supporting surface complementary to the curvature of the glass sheet after bending thereof to receive the glass sheet after it is bent and to retain the curvature in the bent glass sheet, the shaping rail being positioned below the supporting surface of said conveyor rolls when the shaping rail is in the lowered position to facilitate movement of the glass sheet along the path, and positioned above said conveyor rolls when the shaping rail is in the raised position to shape the sheets of glass.

[0027] An object of a preferred embodiment of the present invention is to provide a double production line such that two sheets of glass can be formed at one time. For the smaller side light sheets of glass, the press bending apparatus of this embodiment can bend two pieces of glass at the same time. The double line is especially efficient for processing left and right pieces of glass for automotive side lights.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above, as well as other advantages of the present invention, will become readily apparent to those skilled in the art from the following detailed description of a preferred embodiment when considered in the light of the accompanying drawings in which:

Fig. 1 is a side elevational view, with parts broken away, of a bending apparatus interposed between a glass heating furnace and a glass tempering station and embodying the sheet supporting and conveying apparatus of the invention;
Fig. 2 is an enlarged top plan view taken substantially along line 2-2 of Fig. 1 illustrating the relationship between the conveyor rolls and the shaping rail of the lower press member;
Fig. 3 is an enlarged fragmentary view, partly in section, taken substantially along line 3-3 of Fig. 2, illustrating the drive for the conveyor rolls;
Fig. 4 is an elevational view, partly in section, taken along line 4-4 of Fig. 2 and illustrating in broken lines the lower press member raised for transport;
Fig. 5 is an enlarged sectional view taken substantially along line 5-5 of Fig. 2 showing the roll beams and the mounting of the conveyor roll drive shafts on the mounting track;
Fig. 6 is an enlarged sectional view taken substantially along line 6-6 of Fig. 2 showing a T-nut for securing the mounting track to the roll beam;
Fig. 7 is a perspective view of the lower press member of the press bending apparatus in an operating position with the corner posts, roll beams, and lower member platen omitted;
Fig. 8 is an enlarged elevational view, partly in section and with parts broken away, of the concave conveyor rolls within the shaping ring, showing details of the coupling for connecting the rolls to the drive shafts;
Fig 9. is an elevational view of the roller, partially in section, taken along line 9-9 of Fig. 8; and
Fig. 10 is a sectional view of the coupling taken along line 10-10 of Fig. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0029] Referring now to the drawings, there is shown in Figs. 1-2 a press bending apparatus 10 for bending glass sheets for automotive applications. The process equipment for bending sheets of glass 12 includes a furnace 14 to heat the glass 12 to its softening point, the press bending apparatus 10, and a cooling section (not shown) for tempering or annealing the glass.

[0030] In the heating section with furnace 14, glass sheets 12 are conventionally heated in a controlled manner while carried sequentially through a furnace 14 on aligned conveyor rolls 16. The glass sheets 12, heated to their bending temperature, exit the furnace 14

through an opening 20 in the rear end wall of the furnace 14 and are transferred to the press bending section by preforming conveyor rolls 18.

[0031] The press bending apparatus 10 comprises a skeletal framework, generally in parallel-piped form, including upstanding corner posts 22 interconnected at their top and bottom by longitudinal beams 24 and transverse beams 26 to form a rigid box-like structure. The press bending apparatus 10 includes a conveyor system 28 which is aligned with the preforming conveyor rolls 18 such that the glass sheets 12 received from the preforming conveyor rolls 18 are conveyed and positioned for bending. The press conveyor system 28, as will be hereinafter more fully described, is intended to support and convey the glass sheet 12 after bending while it is at a temperature susceptible to deformation and sagging under adverse conditions.

[0032] Mounted within the framework of the press bending apparatus 10 for reciprocating relative movement toward and away from each other are the upper male press member 30 and the lower female press member 32. The upper and lower press members 30, 32 are provided with opposed complementary shaping surfaces conforming to the curvature to which the flat glass sheets 12 are to be bent.

[0033] The upper press member 30 includes a base structure 34 for supporting a mold element 36 having a downwardly directed, generally convex shaping surface 38 to impart the desired curvature to the sheet 12. The specific outline and curvature of the shaping surface 38 will be dictated by the particular curvature and configuration to be imparted to the glass sheet 12. It is contemplated that the upper mold element 36 may comprise either a continuous shaping surface or a peripheral shaping rail of outline or ring type construction.

[0034] The base structure 34 carrying the upper mold element 36 is affixed to an upper platen 40 which is suspended from the horizontal beam 24 as by shafts 42 extending from screw jacks 44. The screw jacks 44 are connected by drive shafts 46 to a drive unit 48. By operating the drive unit 48, the screw jacks 44 are driven in unison to raise or lower the upper platen 40 and the upper press member 30 carried thereby to selected operating positions. The upper press member 30 may be positioned at the start of a production run and be maintained in the fixed position, or alternatively, the upper press member 30 may be raised and lowered between a rest elevation and a press bending elevation in the bending cycle.

[0035] The lower press member 32 includes an outline or ring type shaping member 50 affixed to a multilayered base 52 in spaced relation thereto by a plurality of adjustable mounting posts 54. The length of the posts 54 can be adjusted to achieve the desired positioning of the shaping ring 50. The shaping ring 50 conforms in outline to the glass sheets 12 to be bent, and is provided on its upper face with a generally concave shaping surface 56 complementary to the upper member shaping surface 38. The shaping ring 50 and its relationship to the bending conveyor system 28 and the base 52 configuration will be hereinafter more fully described.

[0036] The base 52 is carried upon a lower platen 58 mounted for vertical reciprocating movement. Guide means 60 are provided at the corners for confining the lower platen 58 to a precise vertical path defined by the corner posts 22. The lower platen 58 is constructed for vertical movement by a fluid actuator 64 mounted on a mounting frame 62 which is supported by additional longitudinal beams 24 or transverse beams 26 mounted in the middle of the structure. A piston rod 66 of the fluid actuator 64 is affixed to the platform 58 in order to raise and lower the platform 58. The piston rod 66 raises the lower press member 32 and the shaping ring 50 carried thereby, between its lowered position beneath the rolls 68 of the conveyor 28 and its raised position thereabove for lifting a heated sheet of glass 12 from the rolls 68 and pressing the glass 12 against the upper press member 30 and between the complementary shaping surfaces 38, 56 to form the sheet of glass to the desired curvature. Following bending, the piston rod 66 is retracted to lower the shaping ring 50 below the conveyor rolls 68 and deposits the bent sheet of glass thereon for advancement into the adjacent cooling section on conveyor rolls 70.

[0037] Laterally spaced locator stops 72 are appropriately positioned in the path of the advancing glass sheet 12 to stop and precisely position the glass sheet 12 in the desired location relative to the press members 30, 32. Each stop 72 is affixed to a piston rod 74 of a fluid actuator 76. The actuators 76 are operable to raise and lower the stops 72 in timed sequence between an upper position above the bending conveyor system 28 and in the path of movement of the sheets 12 on rolls 68, and a lower position therebeneath.

[0038] The rate of movement of the glass sheets 12 during each phase of the operation is controlled by a motor control system (not shown) to be commensurate with the operation being performed on the glass sheet 12. The variable speed motors used to control the conveyor speed in each of the three phases are all connected to the motor control center such that any adjustments made to vary the speed of the motors (i.e., the furnace conveyor is slowed to increase the temperature of the glass) will effect corresponding adjustments in the rates of speeds of the other conveyor sections to maintain the respective rates of speed proportional.

[0039] For the conveyor system 28 in press bending apparatus 10, the conveyor drive 80 shown in Fig. 3 is used to drive the drive shafts 78 on which the rolls 68 are mounted. The drive shafts 78 are supported by shaft bearings 82 at each end and in the middle of the shaft 78. A variable speed motor 84, gear reduction mechanism 86, and endless chain drive 88 are used to drive pinions 90 connected to three preforming conveyor rolls 18 and a drive pinion 92 connected to a short shaft 94 to drive an input gear on timing belt mechanism 96. The

output of the first timing belt mechanism 96 is used to drive one of the conveyor drive shafts 78A. A second timing belt mechanism 98 is then used to rotatably drive the balance of the shafts 78 in the press bending apparatus 10.

[0040] The lower press member 32 which is mounted on lower platen 58 is shown in more detail in Figs. 4 and 7. The platen table 100 provides a standard means of connection to the lower platen 58. An adapter plate 102 is then bolted to the platen table 100. A base plate 104 for each line is then affixed to the adapter plate 102. A plurality of vertical spacers 106 are used to support a sub-plate 108 on the base plate 104, which creates a lifting means defined by a pair of apertures 110 between the base plate 104 and the sub plate 108. The posts 54 and actuator 76 are mounted on the sub plate 108.

[0041] The apertures 110 are sized for receiving and lifting by the tines 112 (shown in phantom in Fig. 4) of a fork lift, which may be used to lift the lower press member 32 (when disconnected from platen 58) to facilitate installation and removal of the lower press member 32 from the press bending apparatus 10. In addition, the lower press member 32 includes a pair of end walls 114 mounted on the adapter plate 102. Rounded grooves or slots 114 are formed in the upper edge of the end walls to receive and support the conveyor drive shafts 78 during the concurrent installation and removal of the lower press member 32 and bending conveyor system 28.

[0042] The bending conveyor system 28 is independently mounted to the corner posts 22 of the press bending apparatus. The press bending rolls 68 and the lower press member 32 are typically designed for and used exclusively with a specific model of bent glass. Consequently, the bending conveyor system 28 with rolls 68 and the lower press member 32, although mounted independently in the press bending apparatus 10, are concurrently installed and removed from the press bending apparatus 10, and are stored as a unit for subsequent production use.

[0043] The bending conveyor system 28 is mounted on roll beams 118 which are secured to the corner posts 22 by support arms 120 (Figs. 2 and 4-7). Two support arms 120 are welded to the corner posts 22 on each side of the press bending apparatus 10. The support arms 120 extend perpendicular to the corner posts 22 and are generally rectangular in shape. The two roll beams 118 are then welded or bolted to the upper surface of the support arms 120 in parallel relationship. The roll beams 118 remain in a fixed position on the press bending apparatus 10. The roll beams 118 include a longitudinal, inverted T-slot 122 extending the full length of the roll beams 118.

[0044] The shaft bearings 82 which support the conveyor drive shafts 78 are secured to mounting rails or tracks 124 which are mounted on the roll beams 118. The mounting rails 124 include a boss 126 on its bottom surface for aligning the rail 124 in the inverted T-slot 122. The top surface includes a channel 128 for receiving a corresponding lug on the mounting base 130 of the bearing 82. The bearing 82 is secured to the rail 124 by bolts 132. The two mounting rails 124 are secured to the two roll beams 118 by mounting bolts 134 and T-nut 136.

[0045] Two cross bars 138 are connected to brackets 140 mounted on the mounting rails 124. The cross bars 138 provide additional rigidity and ensure alignment when securing the mounting rail 124 to the roll beams 118. When the mounting rails 124 are disconnected from the roll beams 118, and the lower press member 32 and conveyor 28 are being installed or removed from the apparatus 10, the shafts 78 are secured in slots 116 of end walls 114. The bearings 82 are in proximity to the outer surface of the end walls 114 such that the conveyor 28 cannot shift in any direction and is retained in the lower press member 32 for storage purposes.

[0046] As shown in Fig. 4, the tines 112 of a fork lift will initially engage the subplate 108 for lifting the lower press member 32. After a short vertical lift, the tines 112 will also engage the cross bars 138 to simultaneously lift the lower press member 32 and the conveyor 28, which are interlocked to form a single subassembly as described above.

[0047] The press bending apparatus 10 is mounted upon adjustable wheels 142 (Fig. 1) such that the entire press bending apparatus 10 can be removed from the production line and replaced by a like apparatus having the appropriate press bending conveyor 28, upper press member 30, and lower press member 32 for bending sheets of glass 12. In changing the entire press bending apparatus, it is only necessary to disconnect a minimum of drive and control members, substitute one press bending apparatus 10 for another, reconnect the drive and control members, and align and level the press bending apparatus relative to the furnace and cooling unit of the production line. A substantial amount of production time can typically be saved by installing and testing conveyor rolls and shaping members away from the production line.

[0048] The press bending apparatus 10 may include adjustable wheels and leveling supports for alignment and leveling purposes. The apparatus for centering and leveling disclosed in U.S. Patent No. 4,872,898 are incorporated herein by reference.

[0049] In the production facility, rails extending transversely of the production line are used to roll a first press bending apparatus away from the production line, and roll a second press bending apparatus set up for producing the desired piece of bent glass back into position in the production line. Once the press bending apparatus is rolled away from the production line, the apertures 110 in the lower press member 32 are now accessible such that a fork lift can be used to lift lower press member 32 and conveyor 28 from the apparatus 10 and to install a different subassemblies into the apparatus 10.

[0050] The assembly, alignment, and testing of the press bending conveyor 28, the upper press member 30, and the lower press member 32 requires consider-

able time and effort. Once acceptable production is achieved, such subassemblies are typically maintained and stored as completed subassemblies. In production operations where only a limited number of bent glass production models are produced, a separate press bending apparatus 10 could be maintained for each model.

[0051] In production operations where a large number of bent glass models are produced, it is generally preferred to maintain only subassemblies (upper press member 30 and conveyor-lower press assembly 28,32) for each model. The sub assemblies can be stored in racks and then installed in the frame structure of the press bending apparatus 10 when needed for production operations. Consequently, only two or three frame structures and (corner posts 22, beams 24, 26, roll beams 118) with upper platen 40, lower platen 58 and related positioning drive equipment, are generally required in a manufacturing facility. While one press bending apparatus 10 is in use in the production line, the upper press member 30 and the press conveyor-lower press member 28,32 for the next scheduled production model can be installed in the second press bending apparatus 10 for insertion into the production line.

[0052] In changing the upper press member 30, the base structure 34 is unbolted from the upper platen 40. The base structure 34 includes a base plate 146 with adjusting posts 144 to adjust the configuration of the upper mold element 36. The base plate 146 is the structural member to be used for lifting and moving the upper press member 30. A fork lift or other lifting means can be used in removing an upper press member 30 from the press bending apparatus 10 and inserting a different upper press member.

[0053] The lower press member 32 and press conveyor 28 are installed and removed from the press bending apparatus 10 as a unit. The lower press member 32 is attached to the lower platen 58 and the press conveyor 28, including rolls 68 and shafts 78, are attached to the roll beams 118 as described above. Fig. 7 shows the lower press member 32 and press conveyor 28 in an operating position as if such subassemblies were fully attached and in production operation. Once the apparatus 10 has been removed from the production line, and the lower press member 32 is disconnected from the platen 58 and the mounting rails 124 of the conveyor 28 is disconnected from the roll beams 118, the lower press member is lifted by fork lift tines in aperture 110 until the mounting rails 124 are lifted from the roll beams 118 and shafts 78 are supported in slots 116 of end walls 114 (Fig. 4) as described above. The lower press member 32 and conveyor 28 are removed and stored as a subassembly unit, and the appropriate subassembly unit is installed in the press bending apparatus 10 for the next rotation of the subassembly units 10 in the production line. Once the upper press member and the lower press member 32 with conveyor 28 have been assembled, tested, and approved for production use, it is relatively easy to maintain such quality levels on subsequent production use.

[0054] With the just in time delivery system implemented by the automobile manufacturers and with cost pressures to minimize production down time and inventory levels, it is essential that producers of automobile glass have an efficient, reliable, high quality and cost effective means of changing production models. The use of two or more press bending apparatus 10 with interchangeable press member 30, 32 and conveyor 28 subassemblies provides such capabilities.

[0055] One of the key factors in achieving the desired quality with the press bending apparatus 10 is the configuration and relationship between the lower ring member 50 of the lower press member 32 and the rolls 68 in conveyor 28. Overcoming problems in sagging and other degradation of the glass sheet 12 has become more challenging with the decrease in the thickness of the automotive glass for side lights from 0.25 in. to 0.118 in. (3 mm) or less.

[0056] In early press bending apparatus, the press bending conveyor rolls for supporting and conveying the glass sheets in conjunction with the lower press member were straight rolls of uniform diameter extending transversely of the path of travel of the sheets. A series of rolls were disposed within the confines of a continuous open ring of the lower press member and mounted on shafts extending transversely of the path of the glass. After the glass sheets were bent, the rolls provided no support to the outer perimeter of the bent sheets, which caused problems with sagging when using the thinner glass.

[0057] Subsequent developments included the use of flexible rolls which tend to assume the curvature imparted to the bent sheets deposited thereon after press bending, and rolls having arcuately curved intermediate sections which are disposed in a common plane for supporting the sheets prior to bending and then pivoted downwardly to define a supporting surface complementary to the curvature imparted to the sheet for receiving the bent sheet from the lower press member. In these subsequent roll configurations, the lower press member, which is of ring type construction, utilizes a ring type shaping rail comprised at least in part of a plurality of segments arranged end-to-end in the desired outline pattern. The adjacent ends of the shaping rail segments are spaced apart sufficiently to permit passage of the shaping rail between adjacent rolls during raising and lowering of the lower press member in the press bending cycle.

[0058] With the advent of automotive styling of glass sheets having irregular outlines or complex configurations, an additional problems is encountered in that transversely extending rolls may intersect the shaping rail obliquely, or at an acute angle. As a result, the spaces or gaps required in the shaping rail for passage of conventional straight rolls increased to the point that the unsupported, heat-softened, thinner glass may sag into

the gaps and acquire an unacceptable shape.

[0059] Because of the sagging problems in the glass caused by the segmented shaping rail, roll systems have been developed which employ a continuous outline shaping rail to provide uninterrupted support around the periphery of the glass sheet. In U.S. Patent No. 5,004,492 separate individual rolls are provided for supporting and conveying glass sheets inside and outside the shaping rail. A special shaft configuration and drive means is provided beneath the shaping rail between the interior and exterior rolls.

[0060] Another roll configuration is disclosed in U.S. Patent Nos. 5,292,356 and 5,297,669. The concave conveyor rolls are of progressively increasing curvature from the exit end of the furnace into the press bending area, which gradually preforms the glass sheet prior to bending the sheet between the upper and the lower press members. In addition, the press rolls include a U-shape portion at each end of the roll which passes beneath the shaping rail of the lower press member when the rail is in the lowered position. Fig. 3 of U.S. Patent 5,292,356 shows such U-shaped portions of the roll (the "duck under" roll) and the potential sagging problems caused by the lack of support along the curved edges of the glass sheet.

[0061] In the present invention, the preforming conveyor rolls 18 are the contoured type comprising an inner, hollow, stationary core member 148 and an outer, flexible, load carrying sleeve rotatable 150 thereabout. Such contoured conveyor rolls are disclosed and described in U.S. Patent No. 3, 05,794 which is incorporated herein by reference. As shown in Fig. 7, the preforming conveyor rolls 18 of the present invention include two contoured portions 152. Contoured rolls 18 of increasing curvature may be employed leading into the press bending apparatus 10 to preform the glass sheets 12. The post-forming contour rolls 70 are of similar construction and contoured for conveying the bent sheets from the press bending apparatus 10 into the adjacent processing station for cooling the bent glass 12.

[0062] The core member 148 is formed from stainless steel tubing or other similar material. At one end, the core member 148 of conveyor roll 18 extends beyond the rotatable sleeve 150 and is secure against rotation by suitable mounting means 156 on mounting rail 124 of the structural framework. The other end of core member 148 is secured on the opposing mounting rail 124 by a rotatable collar 158. The outer sleeve 150 is also attached to the rotatable collar 158 by coupling member 160. As noted above, the rotation of drive pinion 90 causes the outer sleeve 150 of conveyor roll 18 to rotate in a controlled manner.

[0063] The conveyor 28 of the press bending apparatus 10 includes parallel shafts 78 rotatably connected between the mounting rails 124. The series of rolls 68 which are mounted on the shafts 78 are disposed within the ring type shaping rail 50 of the lower press member 32. Each conveyor roll 68 is formed of a suitable material, such as aluminum. The roll 68 may be hollowed out to form an internal aperture 162 (Fig. 8), which reduces the weight of the roll 68 to be supported on shaft 78, and which also reduces the weight to be lifted when changing out the lower press member 32 and conveyor 28 combination.

[0064] As shown in Fig. 8, each roll 68 has an hour-glass shape such that the ends portions 164 of the roll 68 have a height of **h**. The roll 68 has a progressively diminishing cross section from the end portions 164 inwardly to the center of the roll 68 to provide curved, generally concave supporting surface 166 in front elevation complementary to the curvature of the heat-softened bent glass sheets 12. The support surface provides excellent support for the bent sheets 12 to prevent sagging of the sheets out of their desired shape during conveyance out of the press bending apparatus 10.

[0065] The height **h** of the end portions 164 of rolls 68 must be greater than the thickness of the ring shaping rail 50. Such relationship allows the shaping rail 50 to be formed as a continuous ring and still have the shaping rail 50 be removable from the path of the glass sheet 12 as the glass sheet enters and exits the press bending apparatus 10. The sagging can be reduced or eliminated by minimizing the distance **d** shown in Fig. 8 between the outer edge of the glass sheet 12 and the outer edge of end portion 164. The shaping rail 50 is mounted as close as possible to the end portion 164 to minimize **d**.

[0066] The prior art press bending apparatus which utilize segmented ring shaping rails have gaps in the ring which results in sagging of the heat-softened glass in the gap areas. The prior art continuous ring press bending apparatus also have problems with sagging because the rolls are not capable of providing the desired support at the periphery of the glass sheet. For example, the duck under conveyor roll with continuous ring noted above will have a distance **d** of approximately 5 inches compared to a distance **d** of approximately 1 inch or less in the present invention. In addition, the hour-glass shape of the rolls 68 permits the support surface 166 to continuously support the glass sheet 12 as the rolls 68 are rotated.

[0067] The rolls 68, as shown in Fig. 8, are covered with a suitable material 168 to protect the surfaces of the bent glass sheets 12. The material 168 must be heat resistant, yet soft enough not to mark the surface of the bent glass sheets 12. A suitable material is sold under U.S. Trademark KEVLAR by E.I duPont de Nemours & Co. of Wilmington, Delaware.

[0068] The material 168 on rolls 68 is retained by a retention device at each end of the rolls 68. The retention device shown in Fig. 8 is an O-ring 170 positioned in a retention groove 172 at the end of the roll 68.

[0069] Figs. 9-10 shows the apparatus used to secure the roll 68 to the shaft 78. A hole is drilled in the shaft 78 at the location for positioning one end of the roll 68. A retention key 174 is inserted in the shaft hole. The roll 68 includes an aperture in the end surface 176 for re-

ceiving the key 174 as the roll 68 is slid into position on the shaft 78. A bolt hole is drilled in the end surface 176 for insertion of a locking bolt 178 to retain and secure the roll 68 in the desired position on the shaft 78.

[0070] The press bending apparatus 10 shown in the drawings is a double line with two ring type shaping members 50 and two sets of conveyor rolls 68 mounted within the marginal outline of the ring members 50. Each shaft 78 includes two conveyor rolls 68, one for each of the ring members 50. The press bending apparatus can be set up as a single line for bending one sheet of glass at a time or as a double line for bending two sheets of glass being conveyed in parallel on the conveyor system 28. Minor chanages to the control system would facilitate sensing both sheets of glass 12 during the process and controlling two position stops 72. The double line production capability in the press bending apparatus 10 adds significant production flexibility without a significant increase in the cost of the press bending apparatus 10.

Claims

1. Apparatus (10) for press bending heat-softened glass sheets comprising:

a frame;
a bending mold mounted on said frame for bending sheets (10) of glass, said bending mold including a lower generally horizontally disposed press member (32) having a continuous peripheral shaping rail (50) conforming to a marginal outline of the sheet (12) of glass and an upper horizontally disposed press member (30) opposed to the lower press member (32), the two press members (30, 32) having complemental shaping surfaces;
drive means (64, 66) mounted on said frame for selectively raising and lowering the lower press member (32) to position the shaping rail (50) in a lowered position for receiving a first sheet (12) of glass, in a raised position for shaping the first sheet (12) of glass, and in the lowered position for transferring the first sheet (12) of glass after it is bent and then receiving a second sheet (12) of glass;
a conveyor (28) mounted on said frame for moving the sheets (12) of glass along a predetermined, generally horizontal path from a heating end of said frame into and through a bending area

wherein said lower press member (32) is raised from said lowered position to said raised position, said conveyor (28) including, in the bending area, a plurality of rotatably mounted, parallel, horizontal shafts (78) extending transversely across the path below the shaping rail (50) of the lower press member (32); and
a plurality of conveyor rolls (68),
characterized in that each conveyor roll (68) is longitudinally, rotatably secured on one of the horizontal shafts (78) such that the conveyor rolls (68) are disposed within the marginal outline of said shaping rail (50), said conveyor rolls (68) having opposing end portions extending radially from the shafts (78) and positioned in close proximity to opposing sides of the shaping rail (50), said conveyor rolls (68) having a circular cross section with a progressively diminishing diameter from the end portions to provide a generally concave supporting surface complementary to the curvature of the glass sheet (12) after bending thereof to receive the glass sheet (12) after it is bent and to retain the curvature in the bent glass sheet (12), the shaping rail (50) being positioned below the supporting surface of said conveyor rolls (68) when the shaping rail (50) is in the lowered position to facilitate movement of the glass sheet (12) along the path, and positioned above said conveyor rolls (68) when the shaping rail (50) is in the raised position to shape the sheets (12) of glass.

2. The press bending apparatus defined in claim 1, wherein said conveyor (28) includes a plurality of contoured preform rolls (18) mounted at the heating end of said frame for preforming the sheets (12) of glass prior to entering the bending area.

3. The press bending apparatus defined in claim 2, wherein said conveyor (28) includes a conveyor drive (80) connected to the horizontal shafts (78) and the preform rolls (18) to simultaneously convey sheets (12) of glass to and from the bending area.

4. The press bending apparatus defined in claim 3, wherein said conveyor drive (80) includes a timing belt (96, 98) to drive a plurality of horizontal shafts (78).

5. The press bending apparatus defined in claim 1, including a second bending mold mounted on said frame and a second plurality of conveyor rolls (68) disposed within the marginal outline of a shaping rail (50) in said second bending mold for simultaneous bending of two sheets (12) of glass.

6. The press bending apparatus defined in claim 5, wherein said second bending mold and the first bending mold are positioned in spaced-apart relationship to each other on said frame and aligned in transverse relationship to the path of the glass, wherein a conveyor roll from the first plurality of conveyor rolls (68) and a conveyor roll from the second plurality of conveyor rolls (68) are mounted on a hor-

izontal shaft (78) for parallel processing of the two sheets (12) of glass.

7. The press bending apparatus defined in claim 1, wherein the conveyor rolls (68) are provided with a hollow centre (162).

8. The press bending apparatus defined in claim 1, wherein the conveyor rolls (68) are covered with a soft, heat resistant material (168) for engaging the sheets (12) of glass.

9. The press bending apparatus defined in claim 1, including a positioning stop (72) mounted on said conveyor (28), said positioning stop (72) having a drive means (74, 76) to raise and lower the positioning stop (72) for positioning the sheets (12) of glass in the bending area.

10. The press bending apparatus defined in claim 9, including a controller to control and sequence the operation of said conveyor (28), said positioning stop (72), and the drive means (64, 66) for said bending mold. ***[deletion(s)]***

11. The press bending apparatus defined in claim 1, including a second drive means (48) mounted on said frame for selectively lowering and raising the upper press member (30).

12. The press bending apparatus defined in any one of claims 1 to 11, which is mounted in aligned sequence between a furnace (14) for heating sheets (12) of glass and a cooling section for tempering or annealing bent sheets (12) of glass,
wherein said frame is
a mobile frame, including means for moving said frame transversely into and out of operative position in the aligned sequence, said mobile frame including an upper platen (40) and a lower platen (58) mounted for reciprocating movement within said frame;
wherein a lower base (52) is secured to the lower press member for temporarily mounting the lower press member (32) on the lower platen (58) in said frame, and an upper base (34) is secured to the upper press member (30) for temporarily mounting the upper press member (30) to the upper platen (40) in said frame;
wherein the conveyor (28) is positioned about the lower press member (32) of said bending mold and independently mounted on said frame,
wherein an upper lifting means is formed on said upper base (34) for selectively installing and removing the upper press member (30) from said frame when said frame is moved to an out of line position and the upper base (34) is disconnected from the upper platen (40) in said frame; and
wherein a lower lifting means is formed on said lower base (52), a complementary lifting means formed on said conveyor (28), and an interlocking means formed between said lower base (52) and said conveyor (28) for selectively and simultaneously installing and removing the lower press member (32) and said conveyor (28) from said frame when said frame is moved to an out of line position.

Patentansprüche

1. Vorrichtung (10) zum Druckbiegen von durch Wärme erweichten Glasscheiben, welche aufweist:

einen Rahmen;

eine Biegeform, die auf dem Rahmen angeordnet ist, um Glasscheiben (10) zu biegen, welche Biegeform eine unteres, im allgemeinen horizontal angeordnetes Druckglied (32) mit einer kontinuierlichen peripheren Formungsschiene (50), die einem Randumriss der Glasscheibe (12) entspricht, und ein oberes horizontal angeordnetes Druckglied (30), das dem unteren Druckglied (32) gegenüberliegt, enthält, wobei die beiden Druckglieder (30, 32) komplementäre Formflächen haben;

eine Antriebsvorrichtung (64, 66), die an dem Rahmen befestigt ist für ein selektives Heben und Senken des oberen. Druckgliedes (32), um die Formungsschiene (50) in einer abgesenkten Position für die Aufnahme einer ersten Glasscheibe (12), in einer angehobenen Position zum Formen der ersten Glasscheibe (12) zu positionieren, und in der abgesenkten Position zum Übertragen der ersten Glasscheibe (12), nachdem sie gebogen wurde, und dann zum Aufnehmen einer zweiten Glasscheibe (12);

eine Fördervorrichtung (28), die an dem Rahmen befestigt ist, um die Glasscheiben (12) entlang eines vorbestimmten, im allgemeinen horizontalen Pfades von einem Heizende des Rahmens in und durch einen Biegebereich, in welchem das untere Druckglied (32) von der abgesenkten Position aus in die angehobene Position angehoben wird, welche Fördervorrichtung (28) in dem Biegebereich mehrere drehbar gelagerte, parallele, horizontale Wellen (78) enthält, die sich quer zu dem Pfad unterhalb der Formungsschiene (50) des unteren Druckgliedes (32) erstrecken; und

mehrere Förderrollen (68),

dadurch gekennzeichnet, dass jede Förderrolle (68) in Längsrichtung drehbar auf einer der horizontalen Wellen (78) so angeordnet ist, dass sich die Förderrollen (68) innerhalb des Randumrisses der Formungsschiene (50) befinden, wobei die Förderrollen (68) entgegengesetzte Endbereiche haben, die sich radial von den Wellen (78) erstrecken und in enger Nähe zu gegenüberliegenden Seiten der Formungsschiene (50) positioniert sind, die Förderrollen (78) einen kreisförmigen Querschnitt mit einem sich zunehmend verringernden Durchmesser von den Endbereichen aus aufweisen, um eine im allgemeinen konkave Stützfläche zu schaffen, die komplementär zu der Krümmung der Glasscheibe (12) nach deren Biegung ist, um die Glasscheibe (12) zu empfangen, nachdem sie gebogen ist, und um die Krümmung in der gebogenen Glasscheibe (12) zu erhalten, und wobei die Formungsschiene (50) unter der Stützfläche der Förderrollen (68) positioniert ist, wenn die Formungsschiene (50) in der abgesenkten Position ist, um die Bewegung der Glasscheibe (12) entlang des Pfades zu erleichtern, und über den Förderrollen (68) positioniert ist, wenn die Formungsschiene (50) in der angehobenen Position ist, um die Glasscheiben (12) zu formen.

2. Druckbiegevorrichtung nach Anspruch 1, worin die Fördervorrichtung (28) mehrere konturierte Vorformrollen (18) enthält, die an dem Heizende des Rahmens befestigt sind, um die Glasscheiben (12) vor dem Eintritt in den Biegebereich vorzuformen.

3. Druckbiegevorrichtung nach Anspruch 2, worin die Fördervorrichtung (28) einen Förderantrieb (80) enthält, der mit den horizontalen Wellen (78) und den Vorformrollen (18) verbunden ist, um gleichzeitig Glasscheiben (12) zu und von dem Biegebereich zu transportieren.

4. Druckbiegevorrichtung nach Anspruch 3, worin der Förderantrieb (80) einen Synchronriemen (96, 98) enthält, um die mehreren horizontalen Wellen (78) anzutreiben.

5. Druckbiegevorrichtung nach Anspruch 1, enthaltend eine zweite Biegeform, die an dem Rahmen befestigt ist, und mehrere zweite Förderrollen (68), die innerhalb des Randumrisses einer Formungsschiene (50) in der zweiten Biegeform angeordnet sind, um zwei Glasscheiben (12) gleichzeitig zu biegen.

6. Druckbiegevorrichtung nach Anspruch 5, worin die zweite Biegeform und die erste Biegeform in einer Beziehung in gegenseitigem Abstand voneinander auf dem Rahmen positioniert und in einer Querbeziehung zu dem Pfad des Glases ausgerichtet sind, wobei eine Förderrolle von den mehreren ersten Förderrollen (68) und eine Förderrolle von den mehreren zweiten Förderrollen (68) auf einer horizontalen Welle (78) gelagert sind für eine parallele Verarbeitung der beiden Glasscheiben (12).

7. Druckbiegevorrichtung nach Anspruch 1, worin die Förderrollen (68) mit einem hohlen Mittelbereich (162) versehen sind.

8. Druckbiegevorrichtung nach Anspruch 1, worin die Förderrollen (68) mit einem weichen, wärmebeständigen Material (168) für den Eingriff mit den Glasscheiben (12) bedeckt sind.

9. Druckbiegevorrichtung nach Anspruch 1, enthaltend einen an der Fördervorrichtung (28) angebrachten Positionierungsanschlag (72), welcher Positionierungsanschlag (72) eine Antriebsvorrichtung (74, 76) hat, um den Positionierungsanschlag (72) für die Positionierung der Glasscheiben (12) in den Biegebereich zu heben und zu senken.

10. Druckbiegevorrichtung nach Anspruch 9, enthaltend eine Steuervorrichtung zum Steuern der Arbeitsfolge der Fördervorrichtung (28), des Positionierungsanschlags (72) und der Antriebsvorrichtung (64, 66) für die Biegeform.

11. Druckbiegevorrichtung nach Anspruch 1, enthaltend eine zweite Antriebsvorrichtung (48), die an dem Rahmen befestigt ist, um das obere Druckglied (30) selektiv abzusenken und anzuheben.

12. Druckbiegevorrichtung nach einem der Ansprüche 1 bis 11, die in ausgerichteter Folge zwischen einem Ofen (14) zum Erwärmen von Glasscheiben (12) und einem Kühlabschnitt zum Tempern oder Glühen gebogener Glasscheiben (12) angeordnet ist, worin der Rahmen ein mobiler Rahmen ist, enthaltend eine Vorrichtung zum Bewegen des Rahmens in Querrichtung in eine und aus einer Arbeitsposition in der ausgerichteten Folge, wobei der mobile Rahmen eine obere Platte (40) und eine untere Platte (58) enthält, die für eine hin- und hergehende Bewegung innerhalb des Rahmens gelagert sind;
worin eine untere Basis (52) an dem unteren Druckglied befestigt ist für eine vorübergehende Befestigung des unteren Druckgliedes (32) an der unteren Platte (58) in dem Rahmen und eine obere Basis (34) an dem oberen Druckglied (30) befestigt ist für die vorübergehende Befestigung des oberen Druckgliedes (30) an der oberen Platte (40) in dem Rahmen;
worin die Fördervorrichtung (28) um das untere Druckglied (32) der Biegeform positioniert und unabhängig an dem Rahmen befestigt ist;
worin eine obere Hubvorrichtung an der oberen Ba-

sis (34) ausgebildet ist für eine selektive Installation und Entfernung des oberen Druckgliedes (30) von dem Rahmen, wenn der Rahmen zu einer versetzten Position bewegt ist und die obere Basis (34) von der oberen Platte (40) in dem Rahmen getrennt ist; und

worin eine untere Hubvorrichtung an der unteren Basis (52) ausgebildet ist, eine komplementäre Hubvorrichtung an der Fördervorrichtung (28) ausgebildet ist und eine Verriegelungsvorrichtung zwischen der unteren Basis (52) und der Fördervorrichtung (28) ausgebildet ist für eine selektive und gleichzeitige Installierung und Entfernung des unteren Druckgliedes (32)und der Fördervorrichtung (28) von dem Rahmen, wenn der Rahmen in eine versetzte Position bewegt ist.

Revendications

1. Appareil (10) pour cintrer par compression des plaques de verre assouplies à la chaleur, comprenant :

un châssis ;

un moule de cintrage monté sur ledit châssis et destiné à cintrer les plaques (10) de verre, ledit moule de cintrage comprenant un élément de compression inférieur (32) disposé généralement horizontalement et présentant un rail de façonnage (50) périphérique continu conforme à un profil marginal de la plaque (12) de verre, et

un élément de compression (30) supérieur disposé horizontalement et opposé à l'élément de compression inférieur (32), les deux éléments de compression (30, 32) présentant des surfaces de façonnage complémentaires ;

des moyens d'entraînement (64, 66) montés sur ledit châssis pour relever et abaisser de façon sélective l'élément de compression inférieur (32) de façon à placer le rail de façonnage (50) dans une position abaissée pour recevoir une première plaque (12) de verre, dans une position relevée pour façonner la première plaque (12) de verre, et dans la position abaissée pour transférer la première plaque (12) de verre une fois. cintrée puis recevoir une seconde plaque (12) de verre ;

un transporteur (28) monté sur ledit châssis pour déplacer les plaques (12) de verre le long d'une trajectoire prédéterminée, généralement horizontale, depuis une extrémité de chauffage du dit châssis vers et via une zone'de cintrage dans laquelle ledit élément de compression inférieur (32) est relevé depuis ladite position abaissée vers ladite position relevée, ledit transporteur (28) comprenant, dans la zone de cintrage, une pluralité de tiges (78) horizontales, parallèles, montées de façon à pouvoir pivoter, et s'étendant transversalement à la trajectoire sous le rail de façonnage (50) de l'élément de compression inférieur (32) ;

une pluralité de rouleaux transporteurs (68),

caractérisé en ce que chaque rouleau transporteur (68) est fixé de façon à pouvoir pivoter, longitudinalement, sur une des tiges horizontales (78), de façon telle que les rouleaux transporteurs (68) sont disposés au sein du profil marginal du dit rail de façonnage (50), lesdits rouleaux transporteurs (68) présentant des portions d'extrémité opposées qui s'étendent radialement depuis les tiges (78) et sont positionnées à proximité de côtés opposés du rail de façonnage (50), lesdits rouleaux transporteurs (68) présentant une section circulaire avec un diamètre diminuant progressivement depuis les portions d'extrémité pour fournir une surface de soutien généralement concave complémentaire de la courbure de la plaque de verre (12) après cintrage de celle-ci, afin de recevoir la plaque de verre (12) après qu'elle soit cintrée et de conserver la courbure de la plaque de verre (12) cintrée, le rail de façonnage (50) étant positionné sous la surface de soutien des dits rouleaux transporteurs (68) lorsque le rail de façonnage (50) se trouve dans sa position abaissée pour faciliter le mouvement de la plaque de verre (12) le long de la trajectoire, et positionné au-dessus des dits rouleaux transporteurs (68) lorsque le rail de façonnage (50) se trouve dans la position relevée pour former les plaques (12) de verre.

2. Appareil pour cintrer par compression selon la revendication 1, dans lequel ledit transporteur (28) comprend une pluralité de rouleaux de préforme adaptés (18) montés au niveau de l'extrémité de chauffage du dit châssis pour préformer les plaques (12) de verre avant qu'elles pénètrent dans la zone de cintrage.

3. Appareil pour cintrer par compression selon la revendication 2, dans lequel ledit transporteur (28) comprend un entraînement pour transporteur (80) raccordé aux tiges horizontales (78) et aux rouleaux de préforme (18) pour déplacer simultanément les plaques (12) de verre vers et depuis la zone de cintrage.

4. Appareil pour cintrer par compression selon la revendication 3, dans lequel ledit entraînement pour transporteur (80) comprend une courroie synchrone (96, 98) permettant d'entraîner une pluralité de tiges horizontales (78).

5. Appareil pour cintrer par compression selon la revendication 1, comprenant un second moule de cin-

trage monté sur ledit châssis et une seconde pluralité de rouleaux transporteurs (68) disposés au sein du profil marginal d'un rail de façonnage (50) dans ledit second moule de cintrage pour cintrer simultanément deux plaques (12) de verre.

6. Appareil pour cintrer par compression selon la revendication 5, dans lequel ledit second moule de cintrage et le premier moule de cintrage sont placés selon une relation espacée l'un par rapport à l'autre sur ledit châssis et alignés selon une relation transversale par rapport à la trajectoire du verre, dans lequel un rouleau transporteur de la première pluralité de rouleaux transporteurs (68) et un rouleau transporteur de la seconde pluralité de rouleaux transporteurs (68) sont montés sur une tige horizontale (78) pour un traitement parallèle des deux plaques (12) de verre.

7. Appareil pour cintrer par compression selon la revendication 1, dans lequel les rouleaux transporteurs (68) sont munis d'un centre creux (162).

8. Appareil pour cintrer par compression selon la revendication 1, dans lequel les rouleaux transporteurs (68) sont recouverts d'un matériau doux et résistant à la chaleur (168) permettant d'engager les plaques (12) de verre.

9. Appareil pour cintrer par compression selon la revendication 1, comprenant une butée de positionnement (72) montée sur ledit transporteur (28), ladite butée de positionnement (72) présentant un moyen d'entraînement (74, 76) pour lever et abaisser la butée de positionnement (72) afin de positionner les plaques (12) de verre dans la zone de cintrage.

10. Appareil pour cintrer par compression selon la revendication 9, comprenant un contrôleur destiné à contrôler et ordonner le fonctionnement du dit transporteur (28), de ladite butée de positionnement (72) et du moyen d'entraînement (64, 66) du dit moule de cintrage.

11. Appareil pour cintrer par compression selon la revendication 1, comprenant un second moyen d'entraînement (48) monté sur ledit châssis et destiné à relever et abaisser de façon sélective l'élément de compression supérieur (30).

12. Appareil pour cintrer par compression selon l'une quelconque des revendications 1 à 11, qui est monté en séquence alignée entre un four (14) destiné à chauffer les plaques (12) de verre et une section de refroidissement destinée à tremper et recuire les plaques (12) de verre cintrées,
ledit châssis étant
un châssis mobile, comprenant des moyens pour déplacer ledit châssis transversalement dans et en dehors de la position d'exploitation dans la séquence alignée, ledit châssis mobile comprenant une platine supérieure (40) et une platine inférieure (58) montées pour réaliser un mouvement réciproque au sein du dit châssis ;
dans lequel une base inférieure (52) est fixée à l'élément de compression inférieur pour monter temporairement l'élément de compression inférieur (32) sur la platine inférieure (58) dans ledit châssis, et une base supérieure (34) est fixée à l'élément de compression supérieur (30) pour monter temporairement l'élément de compression supérieur (30) sur la platine supérieure (40) dans ledit châssis ;
dans lequel le transporteur (28) est placé à proximité de l'élément de compression inférieur (32) du dit moule de cintrage et monté indépendamment sur ledit châssis,
dans lequel un moyen de levage supérieur est formé sur ladite base supérieure (34) pour installer et retirer de façon sélective l'élément de compression supérieur (30) du dit châssis lorsque ledit châssis est déplacé vers une position hors ligne et que la base supérieure (34) est déconnectée de la platine supérieure (40) du dit châssis ; et dans lequel un moyen de levage inférieur est formé sur ladite base inférieure (52), un moyen de levage complémentaire formé sur ledit transporteur (28), et un moyen d'interverrouillage formé entre ladite base inférieure (52) et ledit transporteur (28) pour installer et retirer de façon sélective et simultanée l'élément de compression inférieur (32) et ledit transporteur (28) dudit châssis lorsque ledit châssis est déplacé vers une position hors ligne.

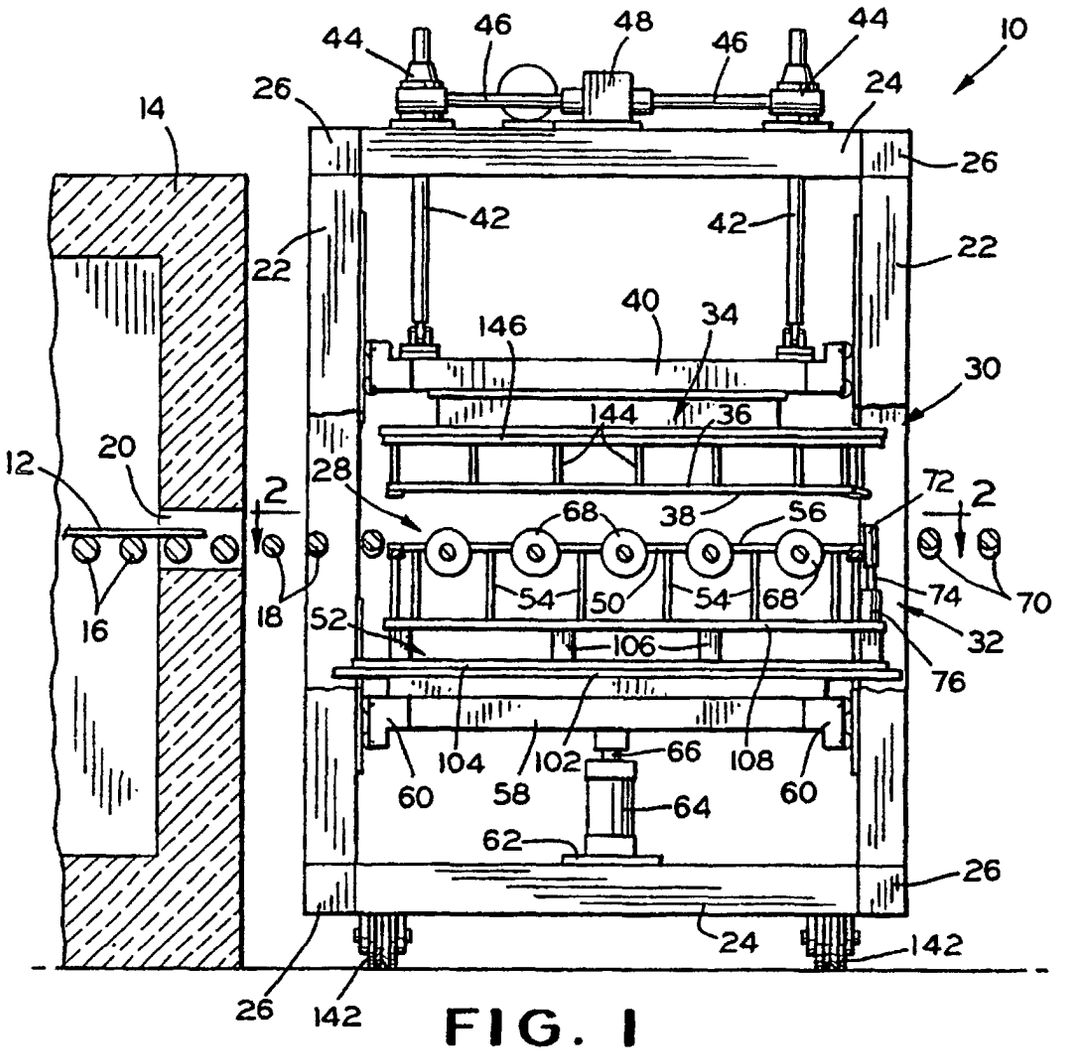
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
102
104
106
108
142
144
146
2
2

FIG. 1

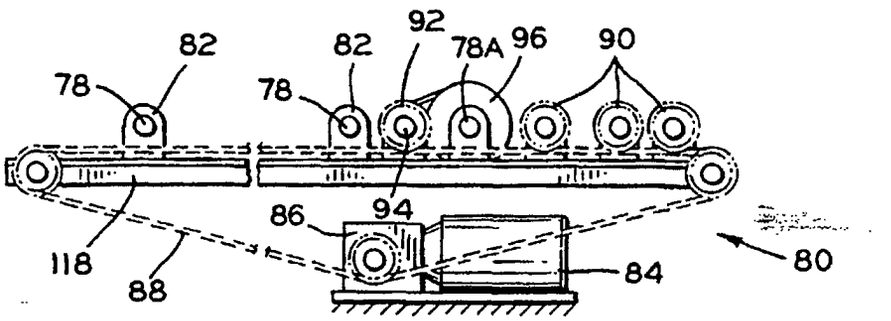
78
82
78
82
92
78A
96
90
86
94
84
80
118
88

FIG. 3

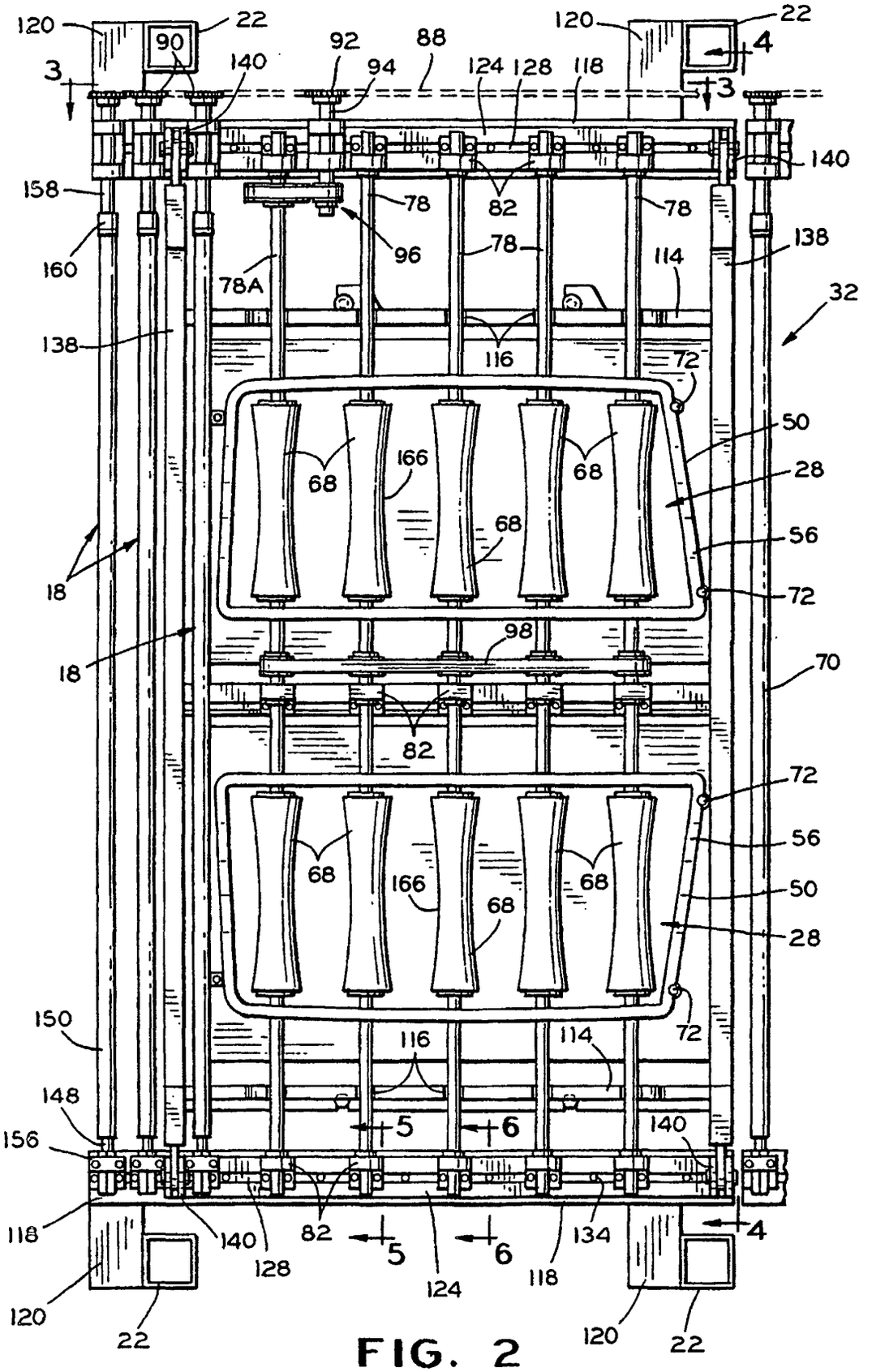
120
22
90
92
88
140
94
124
128
118
3
4
158
78
82
96
160
78A
114
138
32
116
72
50
166
68
28
56
18
98
70
82
150
148
156
5
6
134
124
120
22

FIG. 2

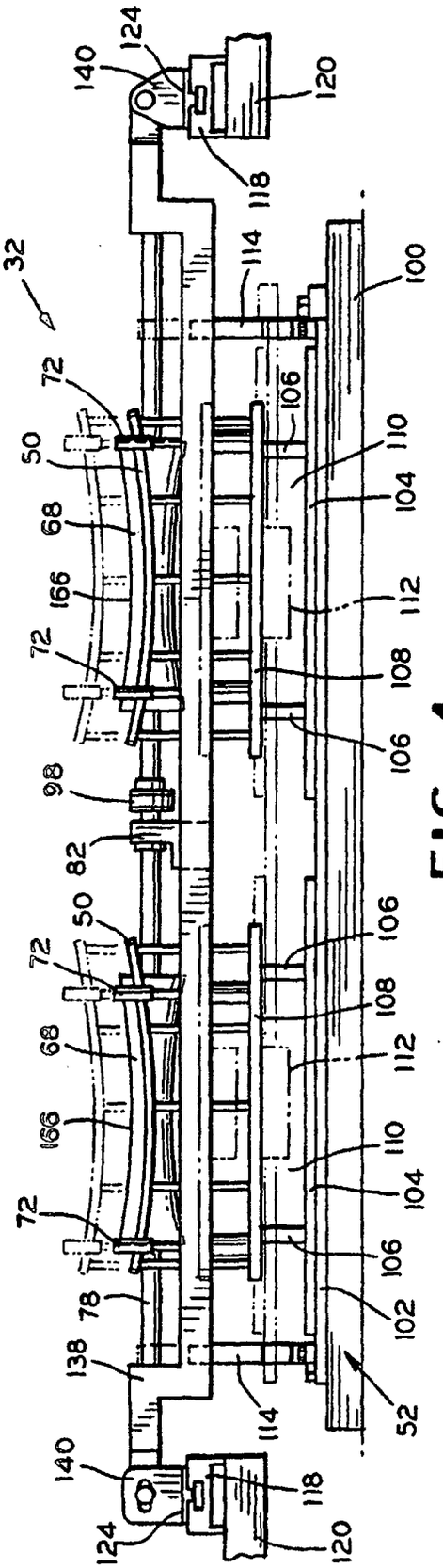

FIG. 4

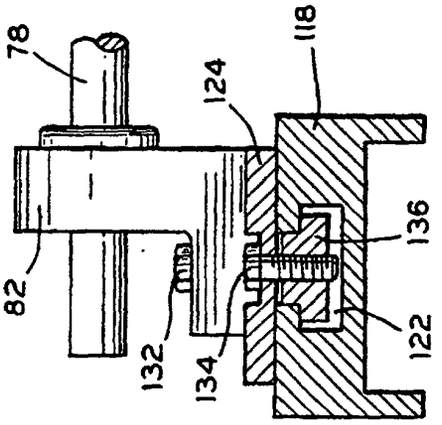

FIG. 6

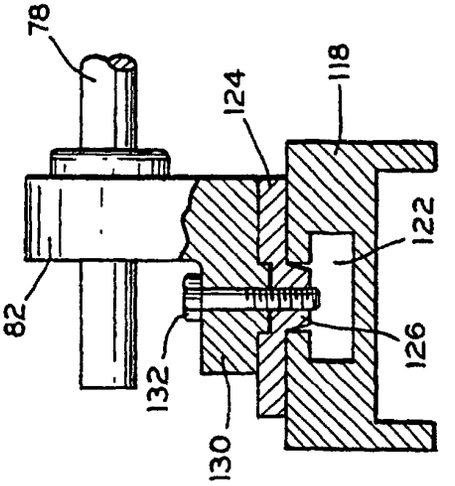

FIG. 5

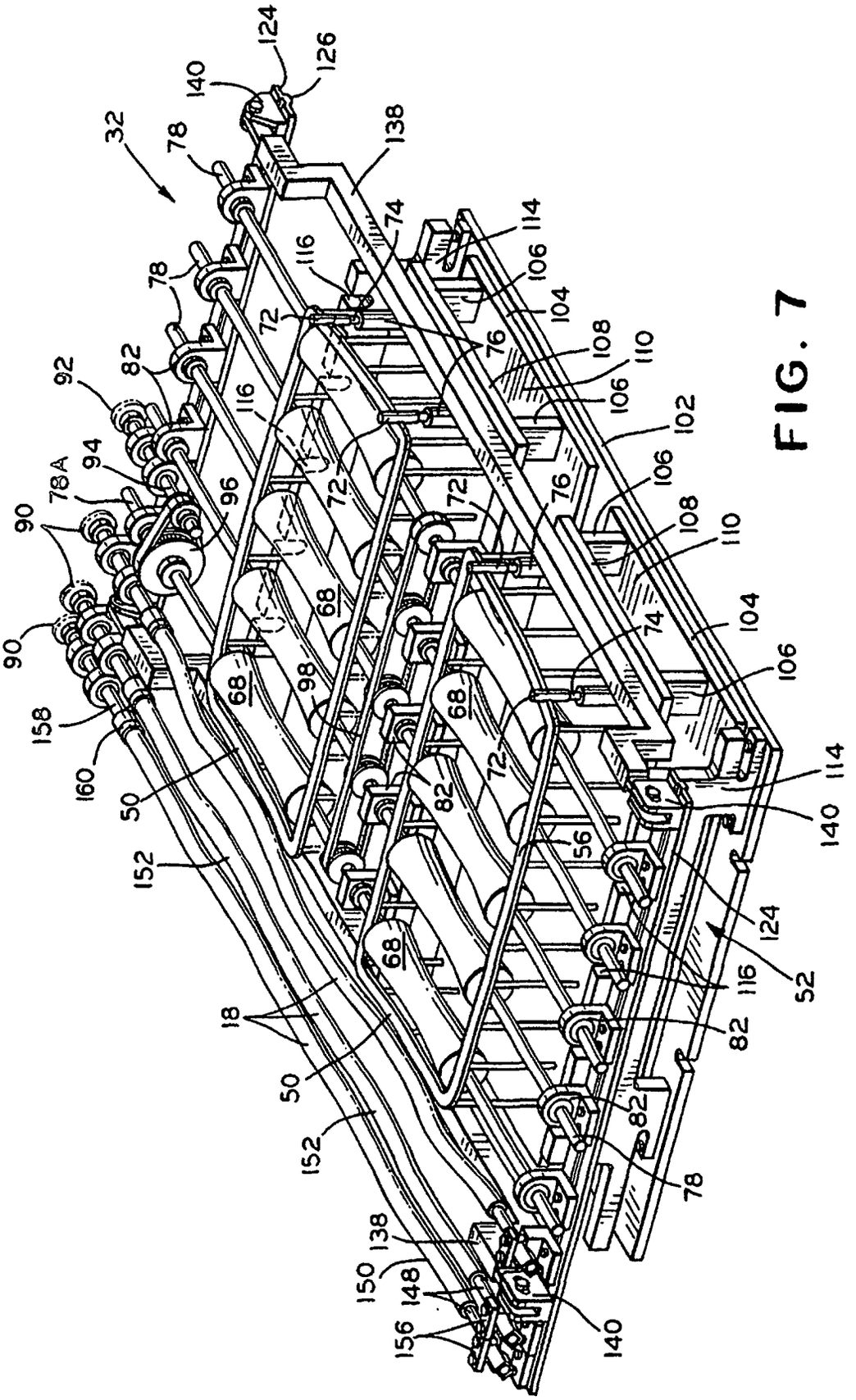
32
78
78A
90
92
94
96
82
116
72
74
76
68
98
102
104
106
108
110
114
124
126
140
138
158
160
50
152
18
56
52
148
150
156

FIG. 7

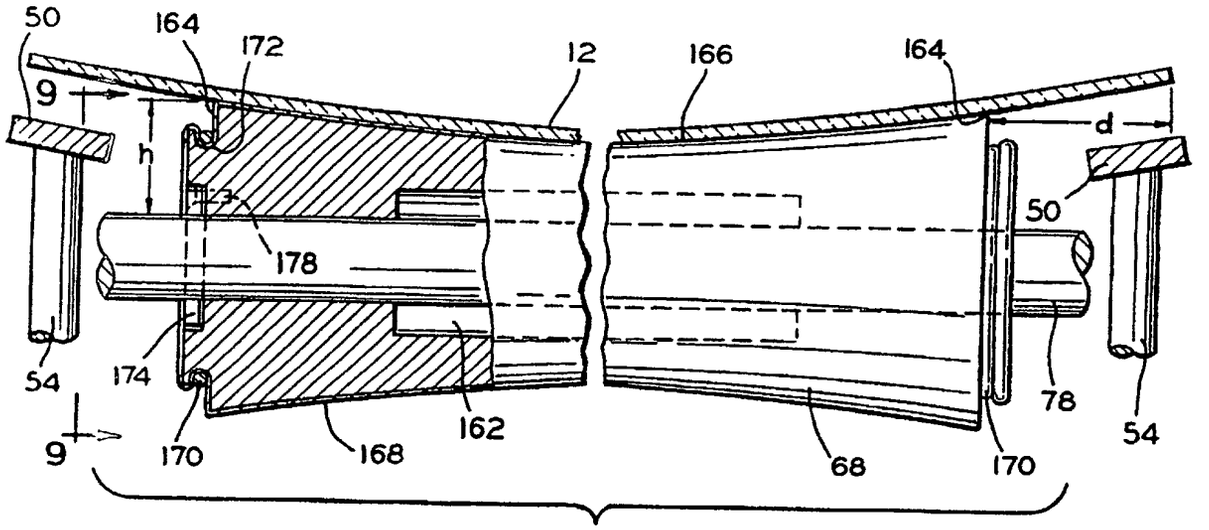

FIG. 8

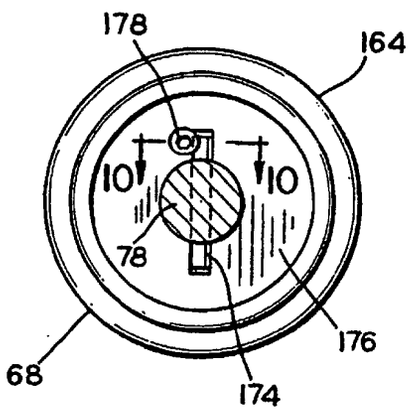

FIG. 9

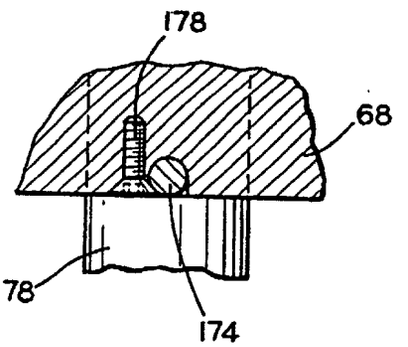

FIG. 10