July 16, 1957 F. A. NICKOL 2,799,307

WOOD ARCH LAMINATING MACHINE AND METHOD

Filed April 8, 1955 3 Sheets-Sheet 1

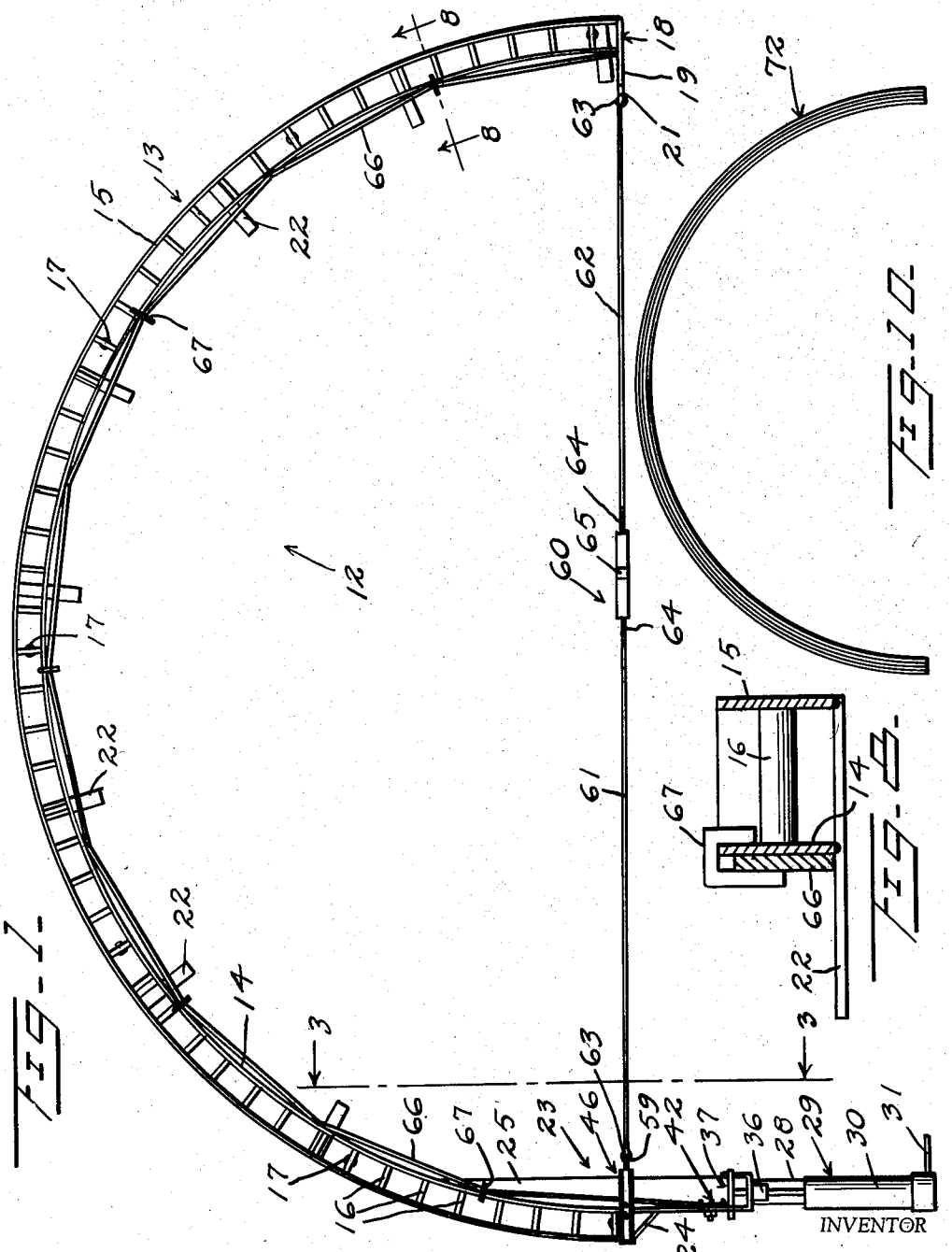


FIG-1

FIG-10

FIG-8

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WOOD ARCH LAMINATING MACHINE AND METHOD

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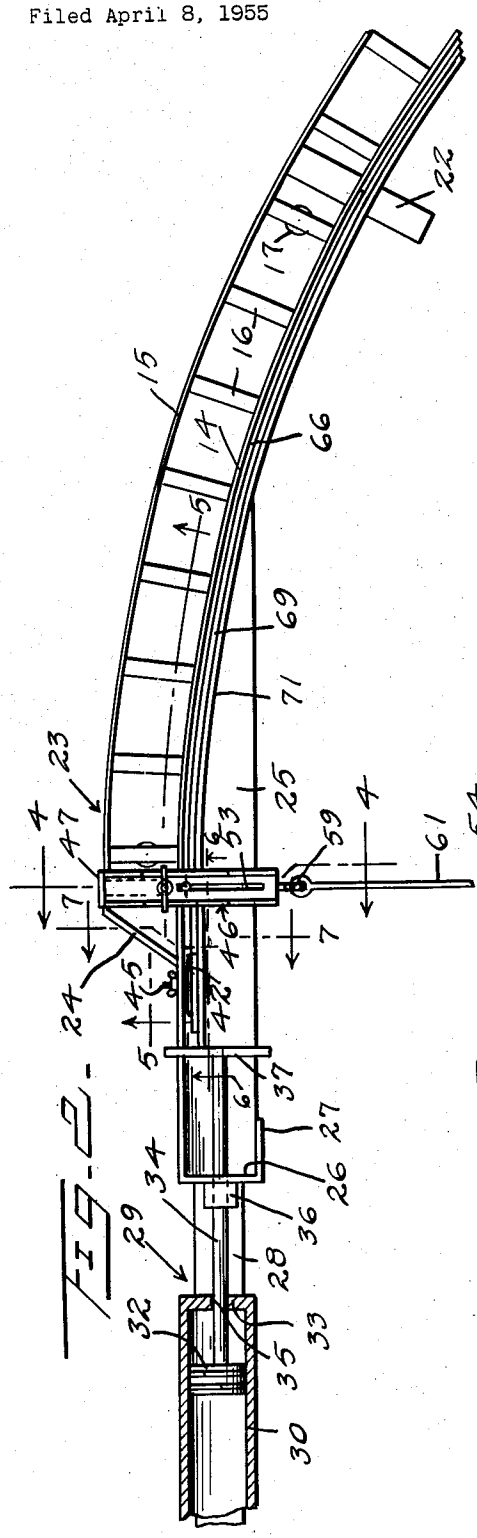


FIG. 2

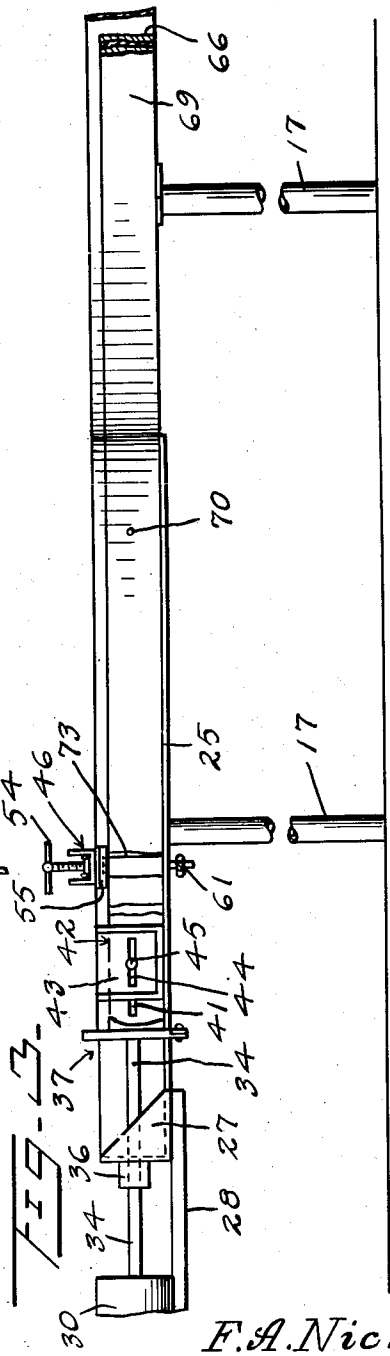


FIG. 3

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WOOD ARCH LAMINATING MACHINE AND METHOD

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FIG. 4.

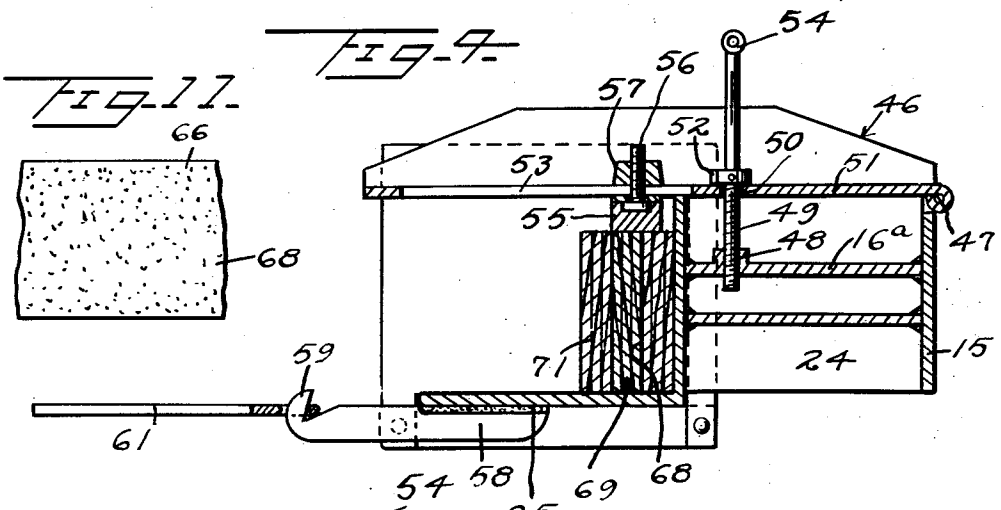


FIG. 11.

FIG. 5.

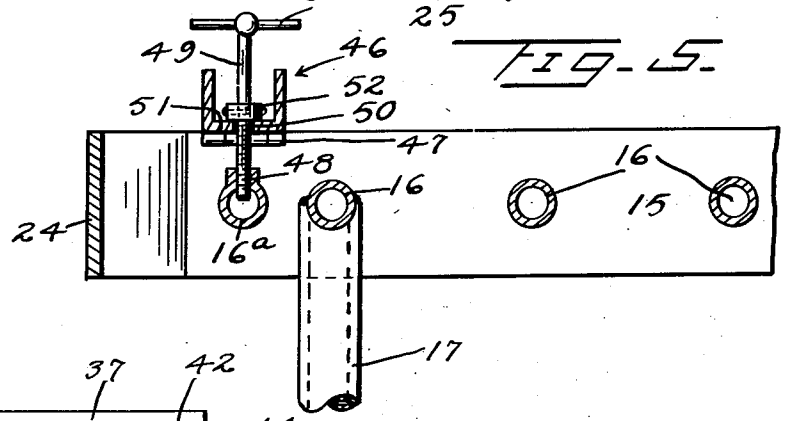


FIG. 6.

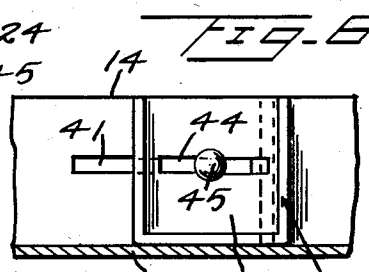


FIG. 7.

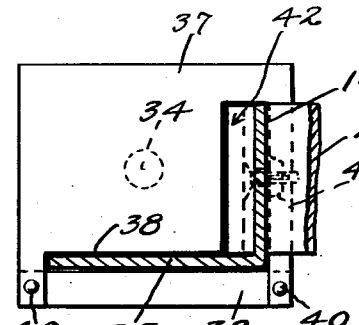
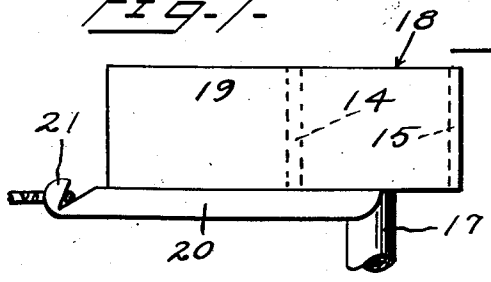


FIG. 9.



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WOOD ARCH LAMINATING MACHINE AND METHOD

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Application April 8, 1955, Serial No. 500,224

7 Claims. (Cl. 144—309)

This invention relates to a machine of simple construction capable of being readily utilized for fabricating laminated wood arches for various uses, as for example in constructing buildings.

More particularly, it is an aim of the present invention to provide a machine which may be readily utilized at the location of a building being constructed for producing laminated wood arches for use therein, thereby eliminating the need for transporting large prefabricated wood arches.

A further object of the invention is to provide a machine of extremely simple construction which is capable of being operated by one man for fabricating the wood arches and which requires no special skill to operate.

A further object of the invention is to provide a machine which can be used for laminating wood arches of different widths and thicknesses and having various numbers of plies.

Still another object of the invention is to provide a machine by means of which wood arches can be quickly laminated with a minimum of labor.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, illustrating a presently preferred embodiment thereof, and wherein:

Figure 1 is a top plan view of the machine;

Figure 2 is a fragmentary top plan view of one end portion of the machine and on an enlarged scale, relative to Figure 1;

Figure 3 is a side elevational view of the end portion of the machine as seen in Figure 2, looking toward the inner side thereof;

Figure 4 is an enlarged cross sectional view, taken substantially along a plane as indicated by the line 4—4 of Figure 2;

Figure 5 is an enlarged fragmentary longitudinal sectional view, taken substantially along a plane as indicated by the line 5—5 of Figure 2;

Figure 6 is an enlarged fragmentary longitudinal sectional view, taken substantially along a plane as indicated by the line 6—6 of Figure 2 and with the arch forming material omitted;

Figure 7 is an enlarged cross sectional view, taken substantially along a plane as indicated by the line 7—7 of Figure 2 with the arch forming material omitted;

Figure 8 is an enlarged detail cross sectional view taken substantially along a plane as indicated by the line 8—8 of Figure 1;

Figure 9 is an enlarged end elevational view looking toward the right-hand end of the machine as seen in Figure 1;

Figure 10 is an edge elevational view, on a reduced scale, of a laminated arch formed by the machine and after removal therefrom, and

Figure 11 is a fragmentary plan view looking toward the inner side of a portion of one ply of the arch.

Referring more specifically to the drawings, the wood

arch laminating machine in its entirety and comprising the invention is designated generally **12** and includes an arcuate frame, designated generally **13**, constituting the form of the machine and which comprises slightly more than a semicircle. The frame **13** includes an inner form wall **14** and an outer reinforcing or bracing wall **15**. The width and thickness of the walls **14** and **15** may vary depending upon the size of the machine **12**. For machines **12** of most sizes, said walls **14** and **15** may be formed of steel of one quarter inch thickness and approximately four inch width. The walls **14** and **15** are connected by a plurality of spacing members **16** each of which comprises a length of pipe or tube, the ends of which are suitably secured to adjacent faces of the walls **14** and **15**. The connecting members **16** may be spaced different distances apart depending upon the size of the machine. The frame **13** is supported at a convenient elevation by a number of legs **17**, upper ends of which are preferably secured in any suitable manner to certain of the connecting members **16** and the lower ends of which are adapted to rest on the ground or other suitable supporting surface, for supporting the frame **13** at a convenient elevation for use, as for example at an elevation of three or four feet above the surface on which the legs **17** rest.

Corresponding ends of the walls **14** and **15** are connected by a rigid plate or bar **18** constituting the right-hand end of the frame **13**, as seen in Figure 1. Said plate **18** extends inwardly from the inner form wall **14** to provide a stop or abutment **19**. As best seen in Figure 7, a metal strap **20** is secured to the bottom edge of the plate **18** and extends to beyond the inner edge of the abutment **19**. The inner end of the strap **20** is provided with an upwardly and outwardly inclined notch forming a hook **21**, for a purpose which will hereinafter be described. A plurality of circumferentially spaced supporting bars **22** are each suitably secured to portions of the bottom edges of the walls **14** and **15** and have unsecured inner end portions which project inwardly from a bottom edge of the inner form wall **14**.

At the other, left-hand end of the machine **12**, as seen in Figure 1 and designated generally **23**, the outer bracing wall **15** has a terminal portion **24** which extends toward and merges with the inner form wall **14**. As clearly illustrated in Figure 2, said inner form wall **14** extends to beyond the terminal portion **24** of the outer wall **15** and is provided with an inwardly extending bottom flange **25** which extends to said last mentioned end thereof from a point spaced a substantial distance therefrom, as seen in Figure 2. Said last mentioned end of the inner wall **14** is provided with a laterally turned inwardly extending transverse wall portion **26** which in turn has an extension **27** which is disposed substantially parallel to a part of the wall **14** and which extends a short distance from the transverse wall **26**.

An elongated supporting member **28** has an inner end disposed against and secured to the underside of the bottom wall **25** and projects therefrom to substantially beyond the transverse wall **26**. A fluid pressure ram, designated generally **29**, such as a hydraulic ram, has a cylinder **30** which is disposed longitudinally on and suitably secured to the supporting member **28**. As seen in Figure 1, a line **31** leading from a suitable source of a hydraulic medium under pressure is connected with and opens into the outer or rear end of the cylinder **30** for pressurizing the rear portion of the cylinder **30** whereby the piston **32** which is contained therein, as seen in Figure 2, will be displaced toward the inner end **33** of the cylinder. A piston rod **34** which is fixed to the piston **32** extends loosely through an opening **35** in the inner end **33** of the cylinder and through

the transverse wall 26 and a guide or boss 36 which is mounted on said wall 26 and which provides a guide for the sliding movement of the rod 34. A ram head 37 is secured to the inner end of the piston rod 34. As best illustrated in Figure 7, a major portion of the ram head 37 is disposed above the bottom wall 25 and inwardly with respect to a part of the wall 14 and is provided with an angular slot 38 in which portions of the walls 14 and 25 loosely fit. The head 37 has a detachable bottom section 39 connected thereto by fastenings 40 and which is disposed beneath the bottom 25 and enables application of the ram head 37 to or removal of the head from the walls 14 and 25.

The inner wall 14, beyond the wall portion 24, is provided with a longitudinally extending slot 41, as best seen in Figure 6. A pressure block 42 is disposed on the inner side of the wall 14 and above the bottom wall 25. The pressure block 42 has a recessed central portion 43 in which is formed a longitudinally extending slot 44 which is adapted to register with the slot 41. The bolt of a bolt and wing nut fastening 45 extends loosely through the slots 41 and 44 for slidably connecting the pressure block 42 to the wall 14. The fastening 45 is adapted to be tightened for clamping the pressure block 42 in different adjusted positions longitudinally of the wall 14, as will hereinafter be described.

An elongated clamp 46 of channel shape cross section is swingably connected as seen at 47 in Figure 4 to a portion of the upper edge of the outer wall 15, adjacent the end portion 24 thereof, for vertical swinging movement. One of the connecting members is disposed immediately beneath the clamp 46 and is designated 16*a*. Said connecting member 16*a* has a vertically extending threaded bore 48 for detachably receiving the threaded lower end of a rod 49 which extends loosely through an opening 50 in the bottom portion 51 of the clamp 46. A collar 52 is secured to the rod 49 and bears on the upper side of the bottom 51 for holding the clamp 46 in an operative position with a part of the bottom thereof bearing on the upper edge of a portion of the inner wall 14. The clamp 46, when thus disposed, as seen in Figure 4, extends inwardly over the bottom wall 25 and the bottom portion thereof which is disposed over the bottom 25 has a longitudinally extending slot 53. The rod 49 has a handle 54 at its upper end which extends transversely thereof, as best seen in Figure 5. A clamping block 55 is disposed beneath the slotted part of the bottom 51 and has an upstanding threaded stud 56 which slidably engages in the slot 53. A wing nut or the like 57 threadedly engages the stud 56 and bears on the upper side of the bottom 51 for supporting the clamping block 55 therebeneath and for clamping the block 55 in selected adjusted positions relative to the bottom 51.

A metal strap 58, similar to the strap 20, is suitably secured to the underside of the bottom 25, as seen in Figure 4, and has an inner end portion extending inwardly therefrom which is provided with a hook 59, similar to the hook 21. The hooks 21 and 59 are connected by tie rod means, designated generally 60, including a pair of rods 61 and 62 having remote ends provided with eyes 63 which engage the hooks 21 and 59. The rods 61 and 62 have spaced apart adjacently disposed threaded ends 64 which engage in the ends of a turnbuckle 65, by means of which said rods may be drawn toward one another. The tie rod means 60 is adjusted to prevent spreading of the frame 13 and so that the frame will form a semicircle between the end wall 18 and the pivoted clamp 46, as seen in Figure 1.

To utilize the machine 12 to form a laminated wood arch, assuming that the machine 12 is set up as illustrated in the drawings and that the turnbuckle 65 has been tightened so that the frame 13 forms a semicircle between the straps 20 and 58, strips of wood 66 are first placed around the inner side of the frame wall 14 in end-to-end relation. The strips of wood 66 may be of various lengths and widths, as for example of two inch, four inch or six inch widths and of lengths greater than the spacing between the supporting bars 22, as for example, approximately sixteen feet in length, so that each strip 66 will rest upon two of the bars 22 with the exception of the strip that rests on the bottom or floor plate 25 and possibly one other of the strips located adjacent thereto. The strips 66 are preferably of about one inch in thickness. One of the strips 66 bears against the end wall or abutment 18, as seen in Figure 1. Each strip 66, intermediate of its ends, is bowed outwardly against the form wall 14 and is connected thereto by a hook member 67 which engages thereover and over the wall 14, as best illustrated in Figure 8. The end portions of the strips 66, by engagement with the wall and due to the tendency of the strips to straighten out, will also be bowed outwardly or toward the wall 14. The fastening 45 of the pressure block 42 is loosened and the pressure block is displaced toward the retracted ram head 37, as seen in Figure 1, so that the outer end of the end strip 66, which bears on the floor plate 25, will abut against the inner end of the pressure block 42. With the strips 66 thus disposed in the machine 12, pressure is supplied to the outer end of the ram cylinder 30 to cause the ram head 37 to move from left to right as seen in Figures 2 and 3 for forcing the pressure block 42 in the same direction. When this occurs, pressure is exerted against the strips 66 and as said strips are disposed with their ends bowed outwardly and in abutting engagement with one another and with their intermediate portions sprung outwardly by the hooks 67, the pressure thus exerted against the strips 66 will cause said strips to yield outwardly and to assume positions in conforming engagement against the form wall 14, as illustrated in Figure 2. The hooks 67 have a sufficient loose engagement with the strips 66 to permit the strips to slide relative to said hooks or to permit the hooks to slide with the strips relative to the wall 14. After the strips 66 are disposed in conformable engagement against the inner side of the wall 14 and with their ends abutting one another and with the remote ends of the end strips 66 abutting the end wall portion 19 and the inner end of the pressure block 42, the fastening 45 is tightened to hold the outer ply of the arch, composed of the strips 66 thus correctly positioned in the frame 13.

The pressure can then be released from the cylinder 30, preparatory to applying another ply to the machine 12. Before the second ply is applied, the hooks 67 are removed and a coating 68 of a bonding medium such as glue is applied to the concave inner side of the strips 66. Strips 69 forming the second ply of the arch are then applied in the same manner as previously described with reference to the strips 66, commencing at the abutment 19. However, the strip 69 which rests on the bottom or floor plate 25 does not engage against the inner end of the pressure block 42 but rather extends across the inner side of said pressure block and therebeyond, as the strips 69 are each slightly longer than the strips 66. Likewise, in applying the second ply, composed of the strips 69, the hooks 67 are not utilized. In lieu thereof, and as illustrated in Figure 3, a nail 70 is driven through each strip 69 substantially intermediate of its ends and is anchored in the strip 66 disposed outwardly thereof for holding the intermediate portion of each strip 69 against a strip 66. Pressure is then again supplied to the ram cylinder 30 to advance the ram head 37 toward the pressure block 42 and into engagement with the end of the strip 69 which extends beyond said pressure block toward the ram head. The strips 69 are thus displaced lengthwise within the frame 13 and are sprung outwardly so that each strip 69, from end-to-end thereof, will conformably engage against the outer ply of the arch composed of the strips 66. As the strips 69 are thus displaced lengthwise, the temporary anchoring nails 70 will be readily drawn out of engagement with the strips 66 and may thereafter be removed.

The clamping bar 46 which was not employed in fabricating the outer ply composed of the strips 66 is then swung counterclockwise about its pivot 47 to its posi-

tion of Figure 4 with a part of its bottom **51** resting on the upper edge of the inner wall **14**. The threaded rod end **49** is then engaged in the threaded bore **48** and tightened to cause the collar **52** to bear on the upper side of the bottom **51** to retain the clamp **46** in its position of Figure 4 and with the clamping block **55** thereof bearing upon the upper edge of a part of the strip **69** which rests on the floor plate **25**. The strips **69** are thus held clamped in the frame **13** while the glue or bonding medium **68** sets for securing said strips **69** to the strips **66**.

After the strips **69** forming the second ply have thus been applied and clamped, a third ply composed of strips **71** are applied to the frame **13** on the inner side of the second ply and in the same manner as previously described in reference to applying the second ply, including attaching each strip **71** intermediate of its ends by a nail **70** to strips **66** and **69**. Before the strips **71** are applied, a coating **68** of the bonding medium is applied to the inner side of the strips **69**. The strips **71** are each slightly longer than the strips **69** so that the strip **71** which engages the floor plate extends toward the head **37** of the retracted ram **29** to beyond the strip **69** which had previously been pushed by the ram. After the strips **71** have had pressure applied thereto by the ram **29** to cause said strips to conformably engage against the coated inner surfaces of the strips **69** and before the ram pressure is released therefrom, the rod **49** is loosened slightly after which the nut **57** is loosened to permit the clamping block **55** to be slid from right to left as seen in Figure 4 to a position overlying the strip **71** which rests on the floor plate **25**. The nut **57** is then tightened, after which the rod **49** is re-tightened for clamping the third ply composed of the strips **71** in the frame **13**.

The aforementioned operation can be repeated until as many plies as desired have thus been fabricated. The completed arch **72** may be composed of as many as eight or ten such plies.

The thickness of the ends of the pressure block **42** correspond to the thickness of the strips **66** one of which abuts thereagainst. Thus, the strip **69** which rests on the floor plate **25** will be disposed in abutting engagement with the inner side of the complementary strip **66** to end of said strip which bears against the pressure block **42**.

After all of the plies forming the arch **72** have been secured together in the frame **13** and sufficient time has elapsed to permit all of the layers of glue **68** to set, pressure on the ram **29** is released to back off the ram head **37**. The rod **49** is disconnected from the threaded bore **48** so that the clamp **46** can be swung clockwise as seen in Figure 4 about its pivot **47** upwardly and outwardly with respect to the frame **13**. As seen in Figure 3, a line or mark **73** is provided on the inner side of the wall **14** in alignment with the inner face of the abutment **19**. The fabricated plies forming the arch are marked off by a line which conforms or aligns with the mark or line **73**, after which the fastening **45** is loosened so that the pressure block **42** may be moved from right to left as seen in Figures 2 and 3, away from the adjacent strip **66**. The arch is then removed from the frame **13**. To enable this to be more readily accomplished, the turnbuckle **65** may be loosened for spreading or opening of the machine **12**. Thereafter, the irregular end of the arch **72** is cut off along the line, not shown, marked by the line **73** to form one end of the completed arch, the other end of which is correctly formed by the ply ends which abut the wall portion **19**.

The arch **72** as thus fabricated is ready to be erected in and as a part of a building.

It will be understood that the machine **12** may be made in various sizes for producing arches **72** of different lengths, widths and thicknesses.

Various modifications and changes are contemplated and may obviously be resorted to, without departing from the function or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. A wood arch laminating machine comprising a frame including an arcuate form wall, means supporting said frame in substantially a horizontal plane with said form wall disposed in substantially a vertical plane, said frame including an end wall having a portion extending inwardly from an end of said form wall and against which ends of complementary strips of wood forming arch plies are adapted to abut, said frame having spaced supporting members extending inwardly from a bottom edge of the form wall and on which bottom edges of the arch forming strips are adapted to rest, a floor plate projecting inwardly from the bottom edge of the form wall and extending lengthwise of the other end of the frame, ram means, supporting means connected to said frame and supporting the ram means beyond the last mentioned end of the frame, said ram means including a head having a part slidably disposed lengthwise of the floor plate and disposed thereabove and inwardly with respect to an adjacent part of said form wall and adapted to successively engage complementary ends of complementary strips forming different plies of the arch for successively displacing each ply of the arch circumferentially of the frame in a direction toward said inwardly extending portion of the end wall for causing each arch ply to be bowed outwardly into a position substantially concentric to said form wall and for causing an outermost arch ply to conformably engage against the inner side of said form wall, and anchoring means adjustably supported on the frame adjacent said floor plate for holding the arch plies under tension in the frame after the endwise pressure exerted thereagainst by said ram means is removed.

2. A machine as in claim 1, said anchoring means including a block slidably disposed against a portion of the inner side of said form wall and having an inner end adapted to abut an end of the outer ply and an outer end adapted to be engaged by the ram head and to be displaced lengthwise of the frame thereby for causing said outer ply to conformably engage against the inner side of the form wall, and means for adjustably clamping said block to the form wall for anchoring the end of the outer ply engaged by the block.

3. A machine as in claim 2, an elongated clamping bar forming a part of said anchoring means pivotally connected to the frame for vertical swinging movement transversely of a part of the form wall, said bar having a portion extending across a part of the upper edge of the form wall and overlying a part of the floor plate in an operative position thereof, fastening means retaining said bar in an operative position, a clamping block adjustably supported by and disposed beneath said bar for engagement with upper edges of inner plies of the arch for clamping portions of said inner plies between said block and a part of the floor plate.

4. A machine as in claim 3, and a plurality of hook members adapted to engage over intermediate portions of each strip of the outer ply and over parts of the form wall for holding the intermediate portions of said outer ply strips against the inner side of the form wall when endwise pressure is applied to the strips for causing the strips to spring outwardly into conformable engagement with the inner side of the form wall.

5. A machine as in claim 1, said frame defining an arc in excess of a semicircle.

6. A machine as in claim 1, said frame including an outer reinforcing wall disposed concentrically around and spaced outwardly from a substantial portion of said form wall, and circumferentially spaced rigid spacing elements having inner ends secured to the outer side of said form wall and outer ends secured to the inner side of said reinforcing wall.

7. The method of fabricating a laminated wood arch comprising positioning a number of wood strips in abut-

ting end-to-end relation to one another on the inner side of an arcuate form, the step of springing the intermediate portion of each strip outwardly, the step of applying endwise pressure to the distal end of one end strip while holding the distal end of the other end strip immovable and while the intermediate portions of each strip is held sprung outwardly for causing each of the strips to conformably engage against a concave side of a form wall, the step of temporarily clamping the end strip to which the pressure was applied for holding the strips forming an arch ply in an arcuate form and in conformable engagement with the form wall, the step of applying an adhesive coating to the inner side of the arch ply, and the repetition of the previously recited steps for forming additional inner plies of the arch each bonded to the ply disposed immediately on the outer side thereof by the previously applied adhesive coating of said next outer ply including

the step of temporarily clamping the end strip to which the pressure was applied for holding the strips constituting the last formed inner ply in an arcuate form and in conformable engagement with the adhesively coated inner side of the next outer ply until the inner ply is securely bonded to said next outer ply, to form a laminated arch comprising a plurality of concentric plies each consisting of a plurality of individual sections disposed in end-to-end relation to one another.

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