July 25, 1961 P. THORKILDSEN 2,993,520

MACHINE FOR PRODUCING TUBE-SHAPED BODIES FROM VENEER SHEETS, ESPECIALLY BARREL SHELLS

Filed Sept. 15, 1958 3 Sheets-Sheet 1

FIG. 1.

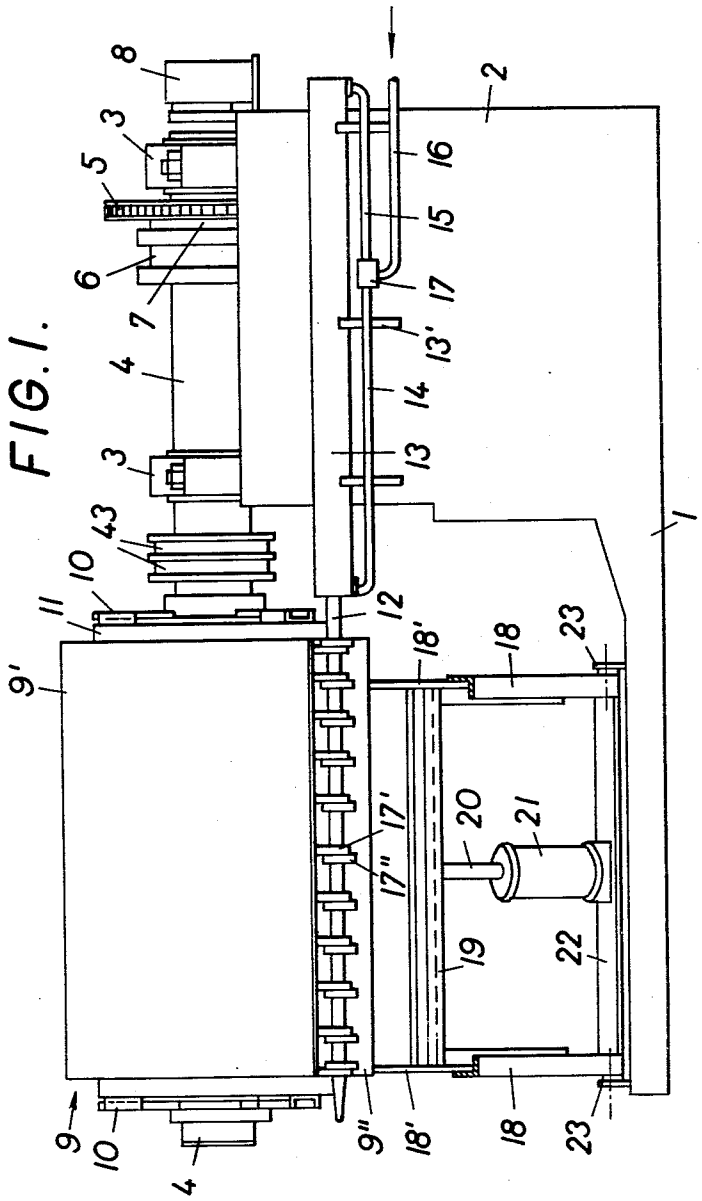
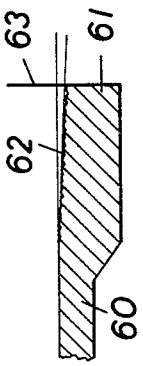


FIG. 5.



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MACHINE FOR PRODUCING TUBE-SHAPED BODIES FROM VENEER SHEETS, ESPECIALLY BARREL SHELLS

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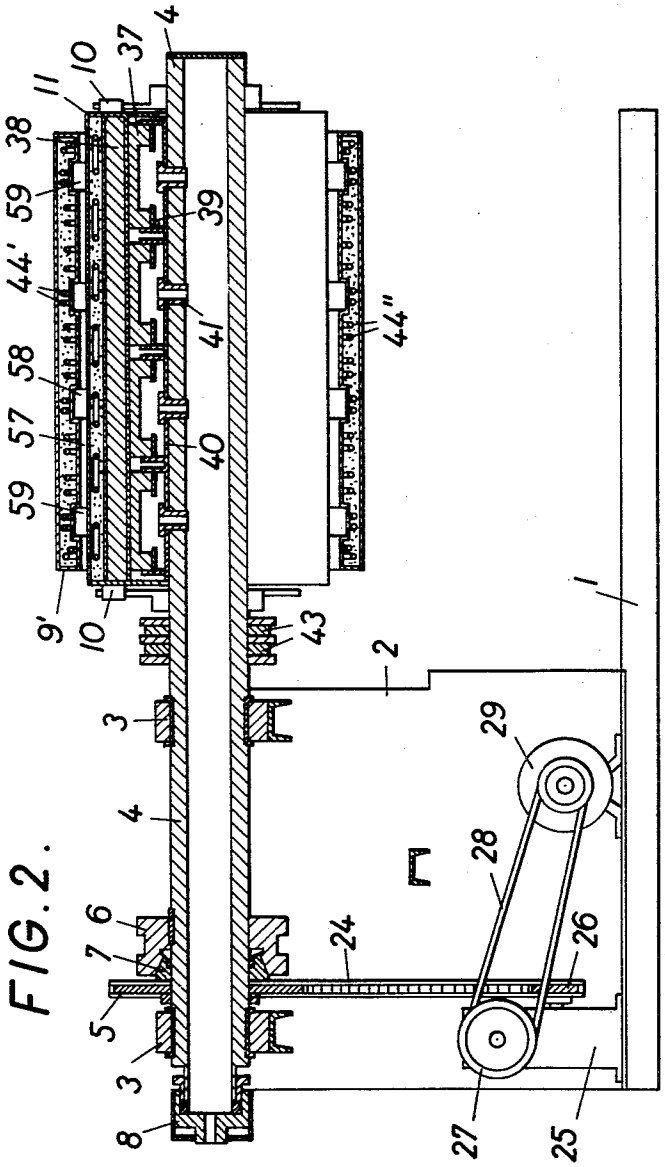

FIG. 2.

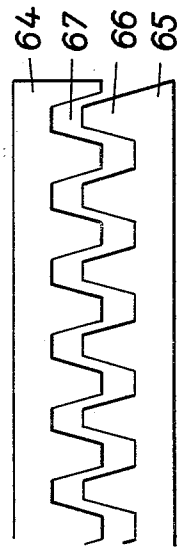

FIG. 6.

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FIG. 3.

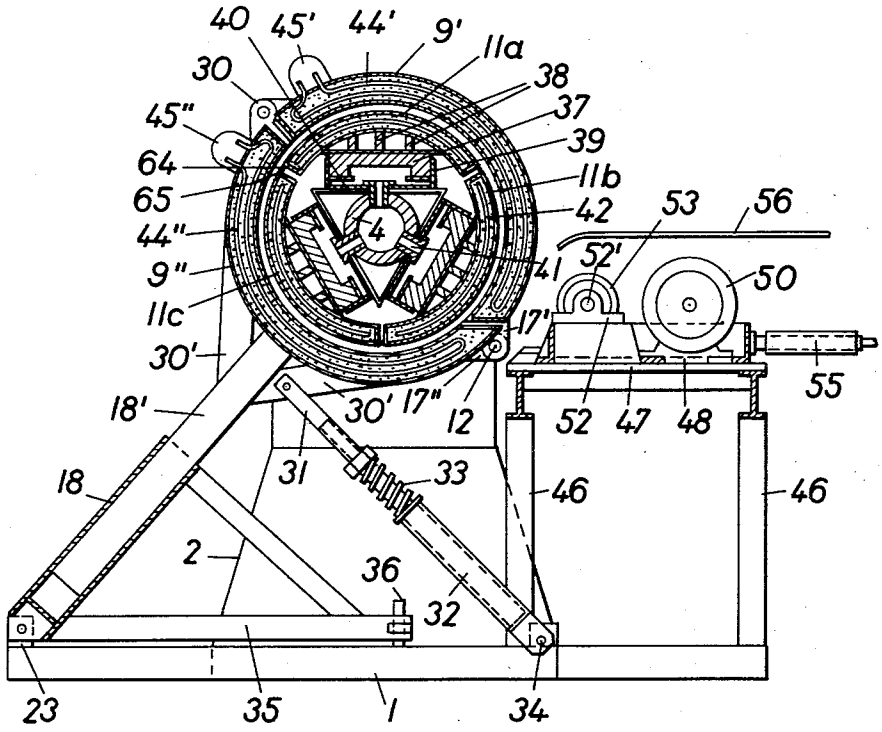
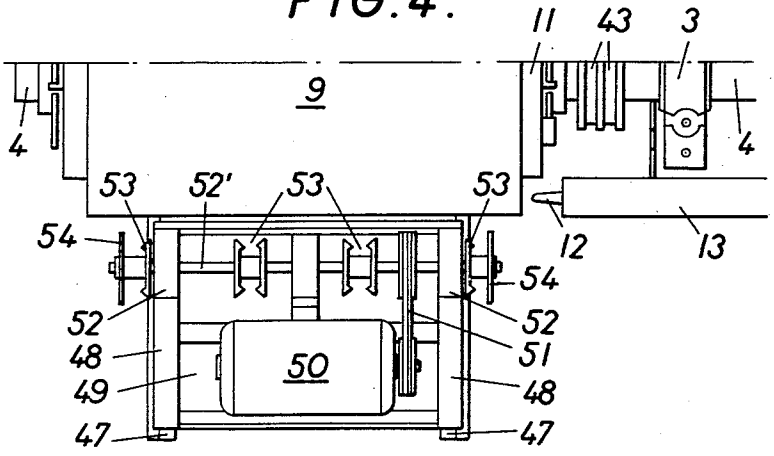


FIG. 4.



United States Patent Office 2,993,520 Patented July 25, 1961

2,993,520

MACHINE FOR PRODUCING TUBE-SHAPED BODIES FROM VENEER SHEETS, ESPECIALLY BARREL SHELLS

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6 Claims. (Cl. 144—268)

The present invention relates to a machine for producing tube-shaped bodies of veneer sheets or plywood, especially barrel shells, the machine being of the type comprising a shaft which is supported at one end and positively rotated, the other end of which carries an expandible mandrel, and a forming casing or shell consisting of two half parts which are hinged together and are provided with locking means so as to be closed and locked together, said mandrel or casing or both being provided with heating elements to develop heat for the hardening of the binder. According to the invention the segments forming the expandible mandrel comprise or are supported by a number of plungers operating radially in relation to the central axis of said mandrel and said shaft, which segments are acted upon by a pressure medium applied through the mandrel for expanding or contracting it.

The invention is described below with reference to the drawings, in which:

FIG. 1 shows a machine in accordance with the invention, as seen from the front with a working table and a finishing or smoothing device removed,

FIG. 2 shows the machine of FIG. 1 in longitudinal cross section,

FIG. 3 is a vertical cross section of the machine;

FIG. 4 is a top plan view of the machine; and

FIGS. 5 and 6 show details of the machine.

The machine shown in the drawings for the production of barrels or tubular bodies comprises a base **1** which is provided at one side with a support **2** provided with bearings **3** for supporting one half of a shaft **4** which is positively rotated by a belt wheel **5**. Belt wheel **5** is coupled with the shaft **4** by a cone clutch, the two members of which are numbered **6** and **7**, respectively. Shaft **4** is hollow and closed at one end (the right end in FIG. 2) whereas the other end is provided with a coupling **8** connected with a conduit for a pressure medium (not shown).

The other or free end of the hollow shaft carries a mandrel **11** normally enclosed by a forming shell or casing **9**. This shell consists of two half parts **9'** and **9''**, the last mentioned one being rigidly connected with arms **18'** the lower ends of which are hinged to the base plate **1** as will be described later on; the other half part **9'** of the shell is hingedly connected with the first-named part by a hinge **30** and may be locked in closed position by a locking device **12**, **17'**, **17''**.

The mandrel consists of three equal segments **11***a*, **11***b* and **11***c* each of which is supported by four plungers **37** and three parallel ribs **38** fixed to the plungers, so that the entire mandrel has twelve plungers in all. These plungers **37** are arranged in short cylinders **39** rigidly connected with the hollow shaft **4** via short sleeves **41** through which the single cylinder spaces communicate with the inner hollow space of the shaft **4**. When air or another suitable medium under pressure is introduced through the coupling **8**, all the plungers are pressed outwardly in radial direction so as to force their respective segments **11** in a direction toward the inner wall of the shell **9**. At both ends of the mandrel the segments **11** are guided by guides **10**.

As seen more particularly in FIGS. 2 and 3, heating elements **42**, **44'** and **44''** are arranged in the segments

and in both halves of the shell **9**, respectively, which elements may either be tube coils to be supplied with steam, or preferably electric resistance wires, with those forming the elements **44'** and **44''** being connected with an outer electric circuit via the terminal boxes **45'** and **45''**, respectively. The connection between the heating elements **42** and the outer electric circuit is via slip rings **34**, the contact brushes of which are not shown in the drawings.

As shown especially in FIG. 6, the longitudinal parallel edges of the segments **11** are provided with saw-toothed bars **64** and **65**, the teeth **66** and **67** of which mesh with each other. This is to reduce denting of the innermost veneer sheet which has its fiber direction arranged parallel with the axis of the mandrel.

As already mentioned above, the half **9''** of the shell **9** is carried by the base **1**. Near each end of half **9''**, arms **18'** protrude downwardly and are inclined in relation to the mean plane of the machine. The two arms **18'** are stiffened by stiffening bars or arms **30'** as shown in FIG. 3. Arms **18'** are guided in channelled guides **18** forming parts of a rigid frame **18**, **22**, **35** which is connected with the rear side of the base **1** via lugs **23** and pins so as to be swung. The angle of inclination of the frame and the arms **18'** may be adjusted by screws **36** which are screwed into the foremost ends of bars **35** rigidly connected with the guide channels **18**. The displacement of the arms **18'** in the guides **18** is hydraulically controlled by a cylinder **21** having a plunger. This cylinder is fixed to the beam **22** interconnecting the lower ends of the channelled guides **18**. The plunger rod **20** is connected with the arms **18'** via a cross beam **19**, as seen in FIG. 1. When a pressure medium is supplied to the cylinder **21**, the entire system consisting of the arms **18'**, **30'**, the beam **19**, and the plunger rod **20**, as well as the shell **9**, may be moved to and from the mandrel **11** when the half **9'** of the shell has been swung away from the mandrel about the hinge **30**.

The system is also under the influence of one or two other hydraulic cylinders **32** which are swingably connected with the base **1** at **34** and the plunger rod **31** of which is connected with one of the stiffening bars **30'**. Between the cylinder **32** and the plunger rod **31** is arranged a helical spring **33** serving to damp shocks.

FIG. 2 also shows the driving means for the shaft **4** in the form of an electric motor **29** disposed interiorly of the support **2** and connected with a belt wheel **27** via a belt **28**. Wheel **27** drives another belt wheel **26** via a worm gearing **25**, and wheel **26** rotates the shaft **4** via the belt wheel **5** and a belt **24**. As already mentioned, the clutch **6**, **7** is shown as an ordinary cone friction clutch which is, in the present case, preferably hydraulically operated.

The locking means for the shell consists of a rod **12** and hinge parts **17'** and **17''** rigidly connected with the two halves **9'** and **9''**, respectively. This locking means is hydraulically operated. The rod **12** forms the outer end of a rod of a piston disposed in a cylinder **13** which is connected with a pressure source through the tube **16**, a valve **17**, and tubes **14** and **15** connected with each one end of the cylinder **13**. This cylinder and the tubes **14** and **15** are supported by brackets **13'** fixed to the front side of the support **2**, as seen in FIGS. 1 and 4.

As seen in FIG. 3, there is provided on the working side at the front of the mandrel **10** and the shell **9** a table **56** upon which the veneer sheets are placed before they are wrapped on the mandrel. Below table **56** is a slicing and finishing machine for the hardened barrel body, as also seen in FIG. 4. The machine is arranged on a carriage **48** sliding on rails **47** supported on posts **46** fixed to the base plate **1**. On carriage **48** is placed a

motor 50 which, via a belt 51, rotates a shaft 52' arranged for rotation in bearings 52. To each end of the shaft is secured a cutting-off saw blade 54 and between the blades 54 are arranged six milling cutters 53. As shown in FIG. 3, the carriage 48 is moved on the rails 47 hydraulically or pneumatically, controlled by means of a cylinder 55 which is connected with a pipe.

When a tube is to be produced, for instance a laminated barrel shell, the veneer sheets are first placed upon one another on the table 56 with alternate fiber direction, either in the form of a stack or preferably, if the barrel body is to be formed of, for instance, five layers, a set of three sheets connected together by paper strips or the like, and upon said three layers two additional layers are placed. A suitable binder is applied to the layers. During this preparatory step, the forming casing 9 is open and pulled back with the half 9' swung away from the mandrel.

The front end of the veneer pack or of the connected sheets is introduced between two of the segments and then the mandrel is rotated by means of the clutch 6, 7 which is operated pneumatically so as to couple the shaft 4 with the belt wheel 5 continuously driven from the motor 29, FIG. 2. First the veneer sheets are wrapped on the mandrel, followed by four veneer strips which are to form girths and end-reinforcements of the barrel body. Preferably the veneer strips are connected with their front ends to the rear edge of the veneer pack or sheets connected together so as to form a combined piece of material to be wrapped upon the mandrel in one continuous operation. After all the veneer sheets and strips have been wrapped upon the mandrel, rotation of the mandrel is stopped and the casing 9 is placed around the mandrel and locked in position by operation of the rod 12. As seen in FIG. 2, the shell has four peripheral grooves 58 and 59 in its inner wall for taking up the veneer strips which form the girths and the end-reinforcements of the barrel. Immediately after the casing 9 has been closed and locked, pressure is applied to the inner space of the shaft 4 through the coupling 8 so that the plungers 37 are pressed outwardly in radial direction to carry with them the segments 11*a*, 11*b* and 11*c* forming the mandrel 11; consequently the segments are pressed against the inner wall of the shell with the wrapped veneer sheets disposed therebetween.

Owing to the fact that the veneer sheets were wrapped on the mandrel when it had its smallest diameter, the movement of the segments will create a peripheral mutual displacement between the veneer sheets so as to bring them tighter together, the liquid binder acting as a lubricant between the layers. Air trapped between the sheets is thereby pressed out and any voids between the laminations are eliminated. During the movement, this outer strip will be pressed into the grooves 58 and 59 against the bottom of the same.

The outer ends of the segments 11 are preferably slightly conical and are rifled in the peripheral direction to form a frusto conical rifled portion 62 at each end of the barrel body, as shown in FIG. 5. These rifled end portions serve the purpose of keeping the bottom and the lid of the barrels in place after they have been applied. As soon as the segments have reached their outermost position pressed tightly against the inner side of the veneer pack, heat is applied to the mandrel 11 and to the casing 9 by the heating elements 42, 44' and 44'' connected with an external electric circuit. As soon as at least a preliminary hardening has taken place, the rod 12 is withdrawn by supplying a pressure medium to the cylinder 13 through the tube 14, whereupon the half 9' of the casing is swung away from the mandrel and the entire casing is retracted.

Immediately thereafter, the pressure medium is supplied to the cylinder 55 to move the cutting-off and finishing device 48, 50, 53, 54 against the mandrel 11 which has, in the meantime, again been put in rotation with the partly hardened veneer shell on it. The motor 50 also rotates, driving the shaft 52' with the tools 53 and 54. During a slow motion of the carriage 48 the saw blades 54 will cut off both ends 63 of the barrel body 60 (FIG. 5). Simultaneously the milling cutters 53 will mill off the sharp edges of the girths and the reinforcing bands. One of these reinforcing bands 61 is shown in FIG. 5 after the corresponding milling tool has milled off the inner edge.

As soon as this finishing work has been completed, the carriage 48 is again withdrawn, whereupon the pressure in the inner of the shaft 4 and the cylinders 39 is released so that the segments 11 are moved back to their initial position. The barrel body may now be pulled off the mandrel and needs to be interiorly milled near the edges to remove the dents or bumps at the places corresponding to the openings between the teeth 66 and 67, as seen in FIG. 6.

I claim:

1. A machine for producing tube-shaped bodies from laminated sheets comprising, in combination, a rotatable shaft carrying at one end an expansible mandrel, a forming casing defined by two hinged halves disposed around said mandrel in spaced relation thereto, said casing being openable to permit entry of the laminated sheets into engagement with said mandrel, and said mandrel being defined by a plurality of circumferentially adjacent segments, and fluid actuatable pistons supporting said segments and carried by said shaft, said shaft containing a conduit for supplying fluid to said pistons to cause said segments to move radially outwardly toward the interior surface of said casing, and means for holding said casing closed.

2. A machine for producing tube-shaped bodies from laminated sheets comprising, in combination, a rotatable shaft carrying at one end an expansible mandrel, a forming casing defined by two hinged halves disposed around said mandrel in spaced relation thereto, said casing being openable to permit entry of the laminated sheets into engagement with said mandrel, and said mandrel being defined by a plurality of circumferentially adjacent segments, and fluid actuatable pistons supporting said segments and carried by said shaft, said shaft containing a conduit for supplying fluid to said pistons to cause said segments to move radially outwardly toward the interior surface of said casing, and at least one of said mandrel and said casing being provided with heating means, and means for holding said casing closed.

3. A machine for producing tube-shaped bodies from laminated sheets comprising, in combination, a rotatable shaft carrying at one end an expansible mandrel, a forming casing defined by two hinged halves disposed around said mandrel in spaced relation thereto, said casing being formed with annular grooves on its inner surface and being openable to permit entry of the laminated sheets into engagement with said mandrel, and said mandrel being defined by a plurality of circumferentially adjacent segments and fluid actuatable pistons supporting said segments, and carried by said shaft, said shaft containing a conduit for supplying fluid to said pistons to cause said segments to move radially outwardly toward the interior surface of said casing, and at least one of said mandrel and said casing being provided with heating means, and means for holding said casing closed.

4. A machine for producing tube-shaped bodies from laminated sheets comprising, in combination, a rotatable shaft carrying at one end an expansible mandrel, a forming casing defined by two hinged halves disposed around said mandrel in spaced relation thereto, said casing being openable to permit entry of the laminanted sheets into engagement with said mandrel and said mandrel being defined by a plurality of circumferentially adjacent segments and fluid actuatable pistons supporting said segments and carried by said shaft, said shaft containing a conduit for supplying fluid to said pistons to cause said

segments to move radially outwardly toward the interior surface of said casing, and the ends of said segments each having a conical enlargement, and means for holding said casing closed.

5. A machine for producing tube-shaped bodies from laminated sheets comprising, in combination, a rotatable shaft carrying at one end an expansible mandrel, a forming casing defined by two hinged halves disposed around said mandrel in spaced relation thereto, said casing being openable to permit entry of the laminated sheets into engagement with said mandrel, and said mandrel being defined by a plurality of circumferentially adjacent segments and fluid actuatable pistons supporting said segments, and carried by said shaft, said shaft containing a conduit for supplying fluid to said pistons to cause said segments to move radially outwardly toward the interior surface of said casing, and the ends of said segments each having a conical enlargement which is rifled peripherally, and means for holding said casing closed.

6. A machine for producing tube-shaped bodies from laminated sheets comprising, in combination, a rotatable shaft carrying at one end an expansible mandrel, a forming casing defined by two hinged halves disposed around said mandrel in spaced relation thereto, said casing being openable to permit entry of the laminated sheets into engagement with said mandrel, and said mandrel being

defined by a plurality of circumferentially adjacent segments and fluid actuatable pistons supporting said segments, and carried by said shaft, said shaft containing a conduit for supplying fluid to said pistons to cause said segments to move radially outwardly toward the interior surface of said casing, the ends of said segments each having a conical enlargement which is rifled peripherally, and at least one of said mandrel and said casing being provided with heating means, and means for holding said casing closed.

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