

[54] **I-BEAM TYPE TRUSS JOIST FORMING APPARATUS WITH AUTOMATED WEB INFEED**

[75] Inventors: **Arthur L. Troutner; John R. Russell**, both of Boise; **Stanley J. Wilmoth**, Eagle; **Alan W. Johnson**, Boise, all of Idaho

[73] Assignee: **Truss Joist Corporation**, Boise, Idaho

[22] Filed: **Apr. 23, 1973**

[21] Appl. No.: **353,242**

[52] U.S. Cl. .... **156/560; 52/729; 106/2; 117/149; 144/3 R; 144/136 R; 144/255; 144/315 R; 156/257; 156/258; 156/304; 156/535; 214/8.5 A; 214/8.5 G; 271/3.1; 271/24; 271/157; 271/158**

[51] Int. Cl. .... **B27d 1/10; B32b 1/10**

[58] Field of Search .... **156/257, 258, 266, 289, 156/304, 313, 390, 516, 517, 529, 535, 556-560, 563-566, 570-575, 578, 236, 237, 278, 354, 531-533, 543, 544, 546; 144/3, 136, 255, 315, 320; 29/200 J, 238; 52/729; 106/2; 117/6, 149; 118/227, 228, 259; 214/8.5 A, 8.5 G; 271/3.1, 24, 157-159**

[56] **References Cited**  
**UNITED STATES PATENTS**

936,472 10/1909 Pfanhauser ..... 118/227 X

1,377,891 5/1921 Knight ..... 52/729  
2,008,974 7/1935 Weber ..... 156/516  
3,060,980 10/1962 Cook ..... 144/3 R  
3,583,889 6/1971 Califano et al. .... 156/516  
3,616,091 10/1971 Troutner ..... 156/257

*Primary Examiner*—Clifton B. Cosby

*Assistant Examiner*—John E. Kittle

*Attorney, Agent, or Firm*—Eugene D. Farley

[57] **ABSTRACT**

In I-beam type truss joist forming apparatus comprising means for successively cutting continuous longitudinal grooves in the opposed side faces of a pair of laterally spaced wooden chords, applying glue to the grooves, compressing the side margins of a plurality of wooden web members to form beveled margins and inserting the web margins into the chord grooves there is provided means for rendering the apparatus adjustable to accommodate chords of different thickness and webs of different widths; means for guiding the chords in longitudinal operating paths; automated apparatus for feeding the webs one at a time between the chords; improved means for compressing the longitudinal margins to the precise bevel required for a precision fit in the grooves of the chords; and means for locating the webs with their compressed side margins registering with the grooves in the chords and for maintaining them in this operative relationship pending and during the I-beam assembly operation.

**21 Claims, 25 Drawing Figures**

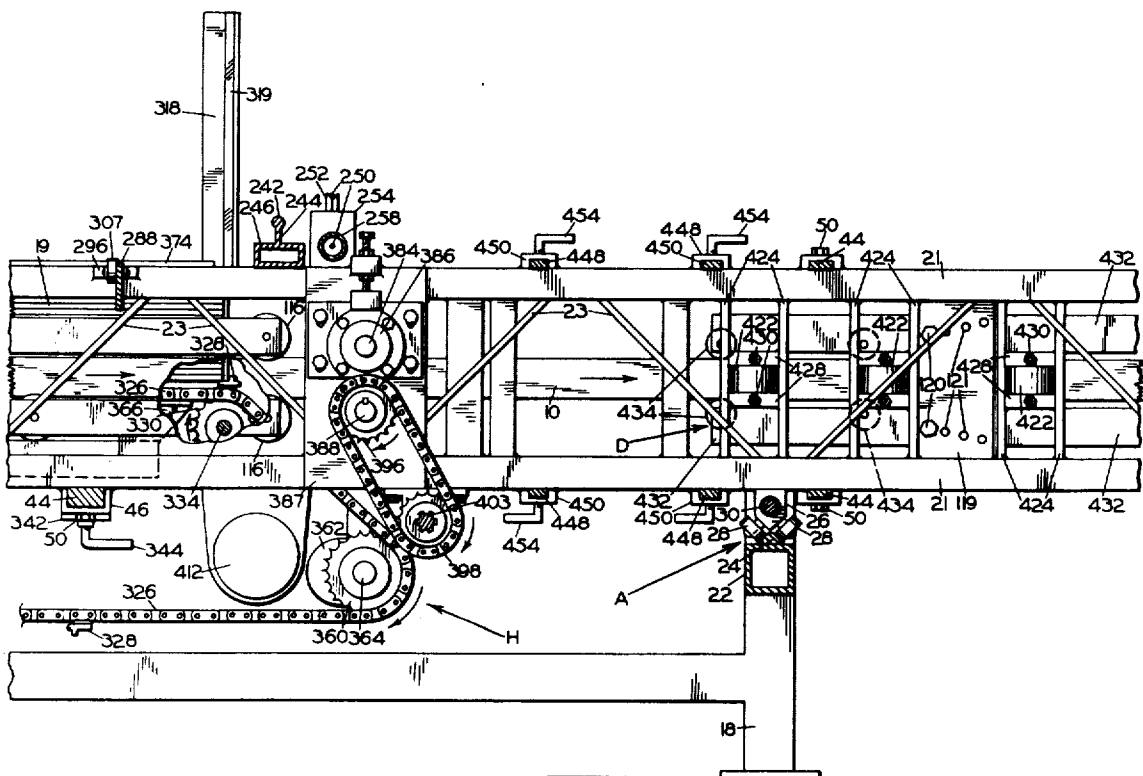


**FIG. 1A**

**FIG. 18**

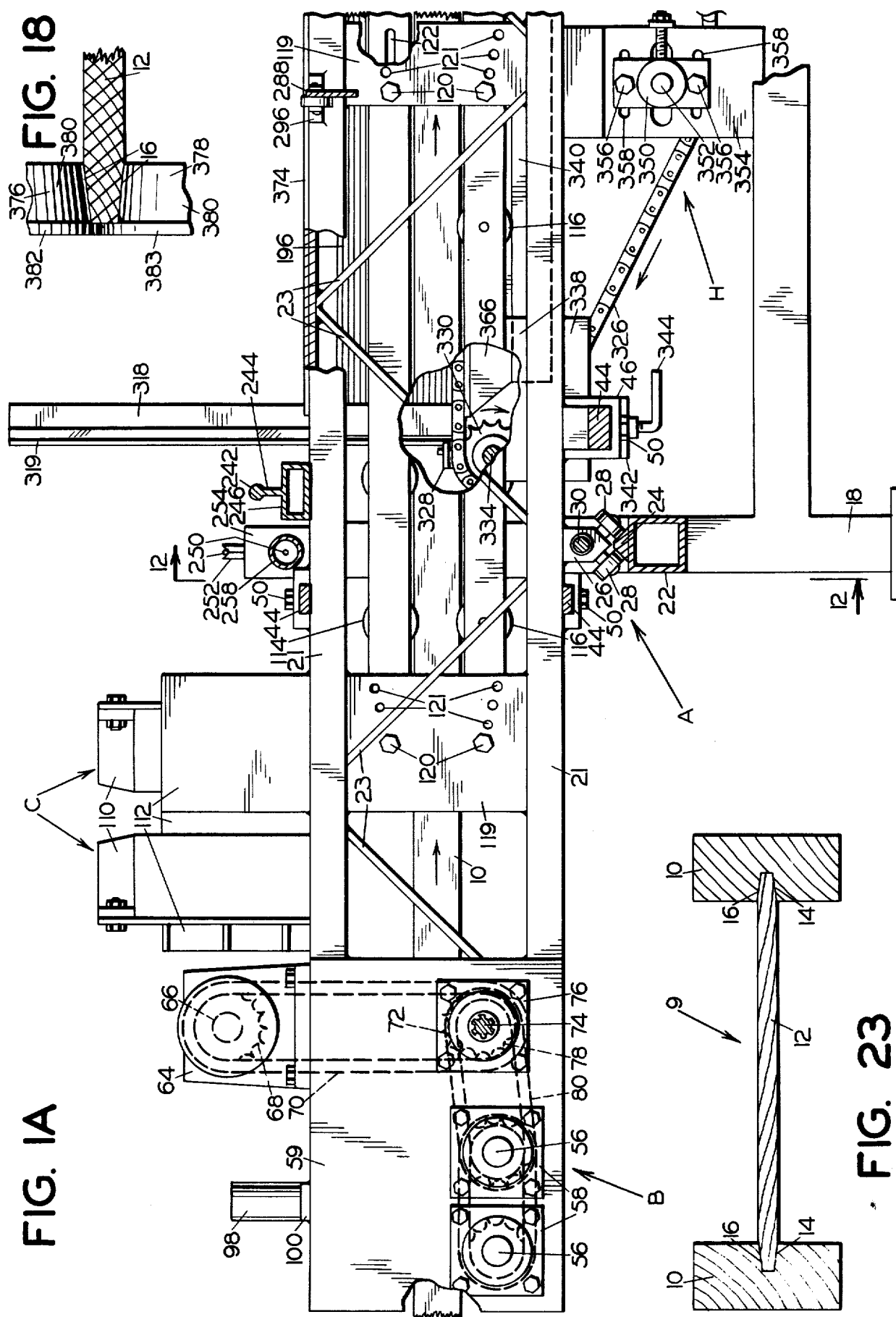


FIG. 1B

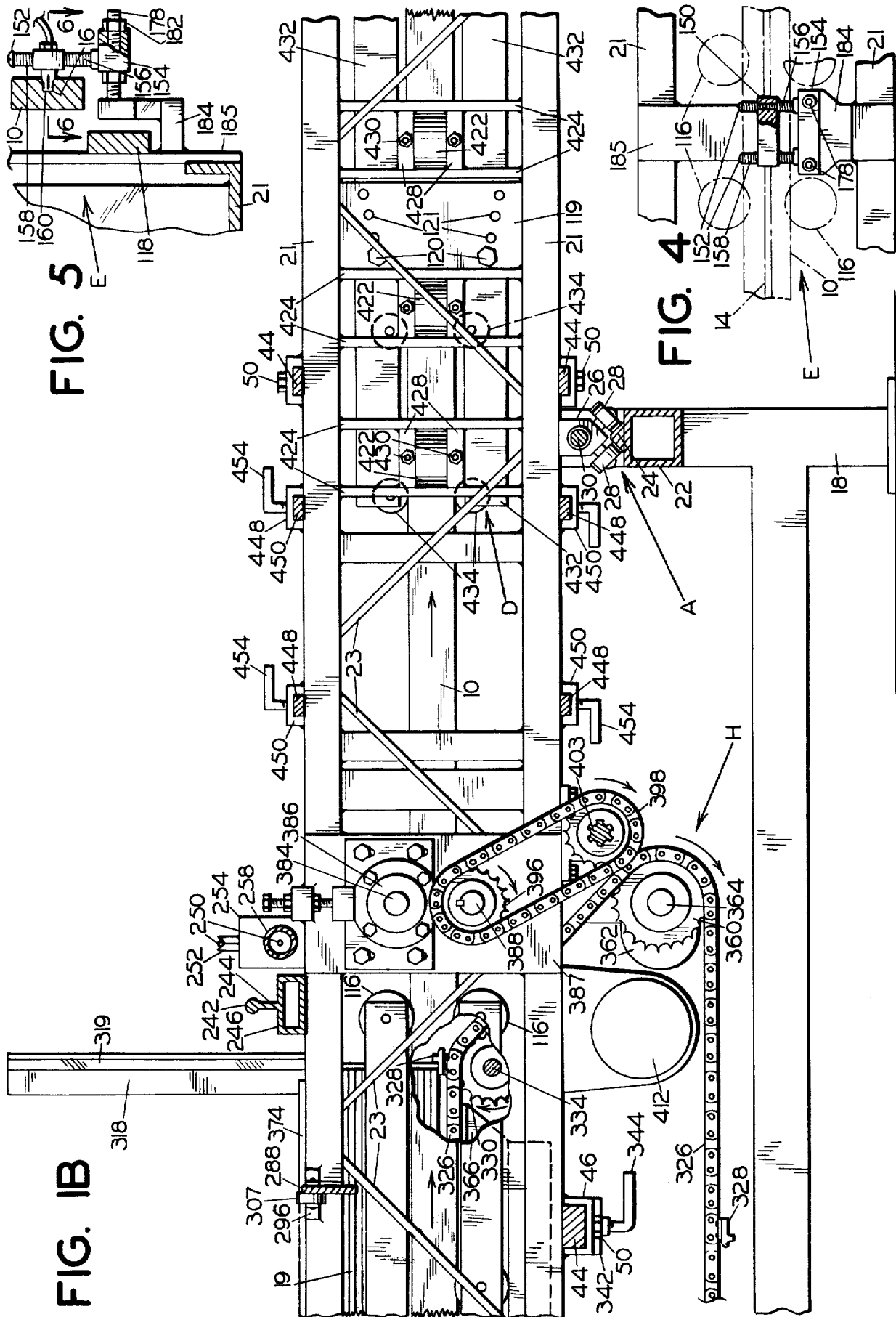
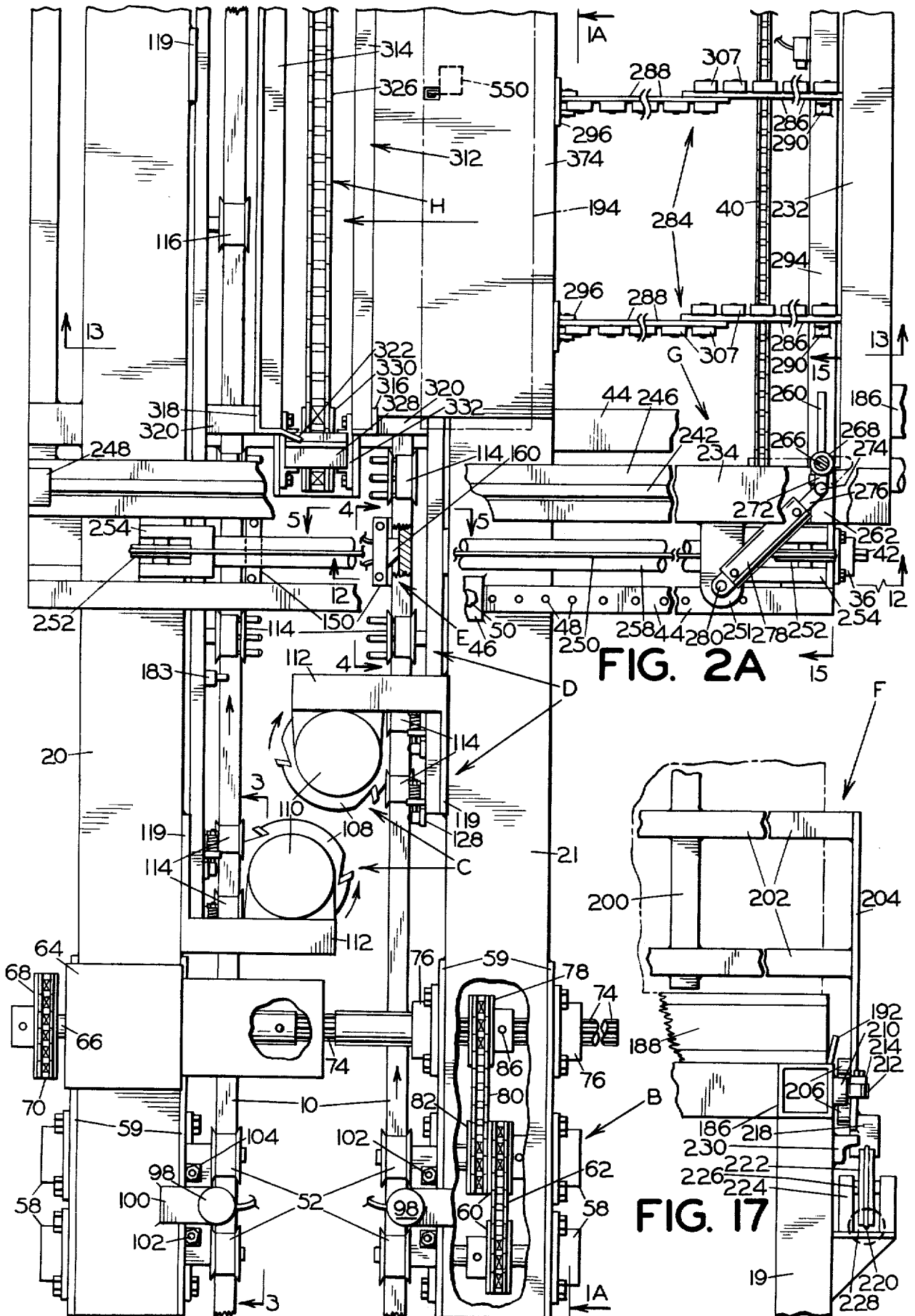


FIG. 5

FIG. 4



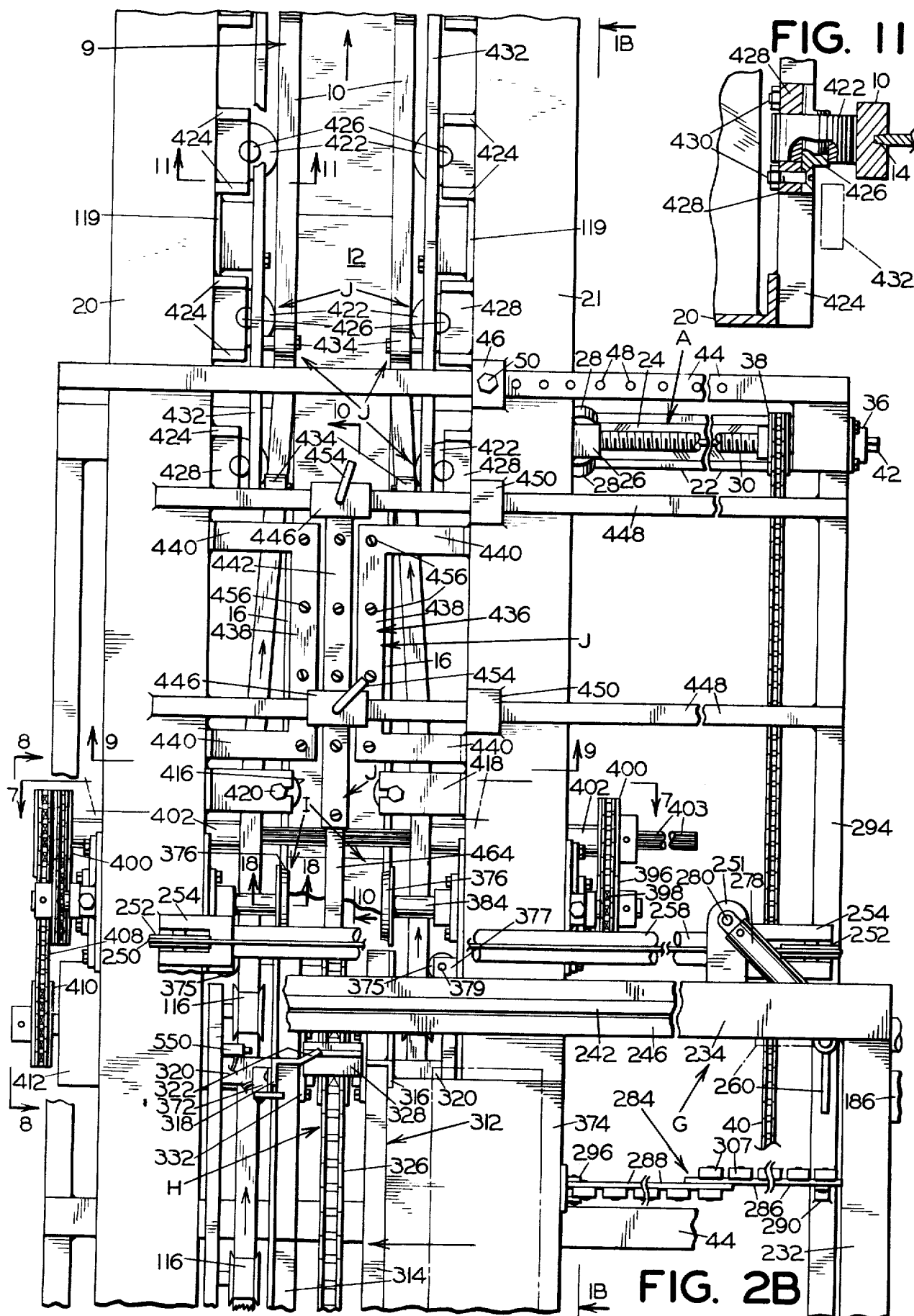


**FIG. 16**

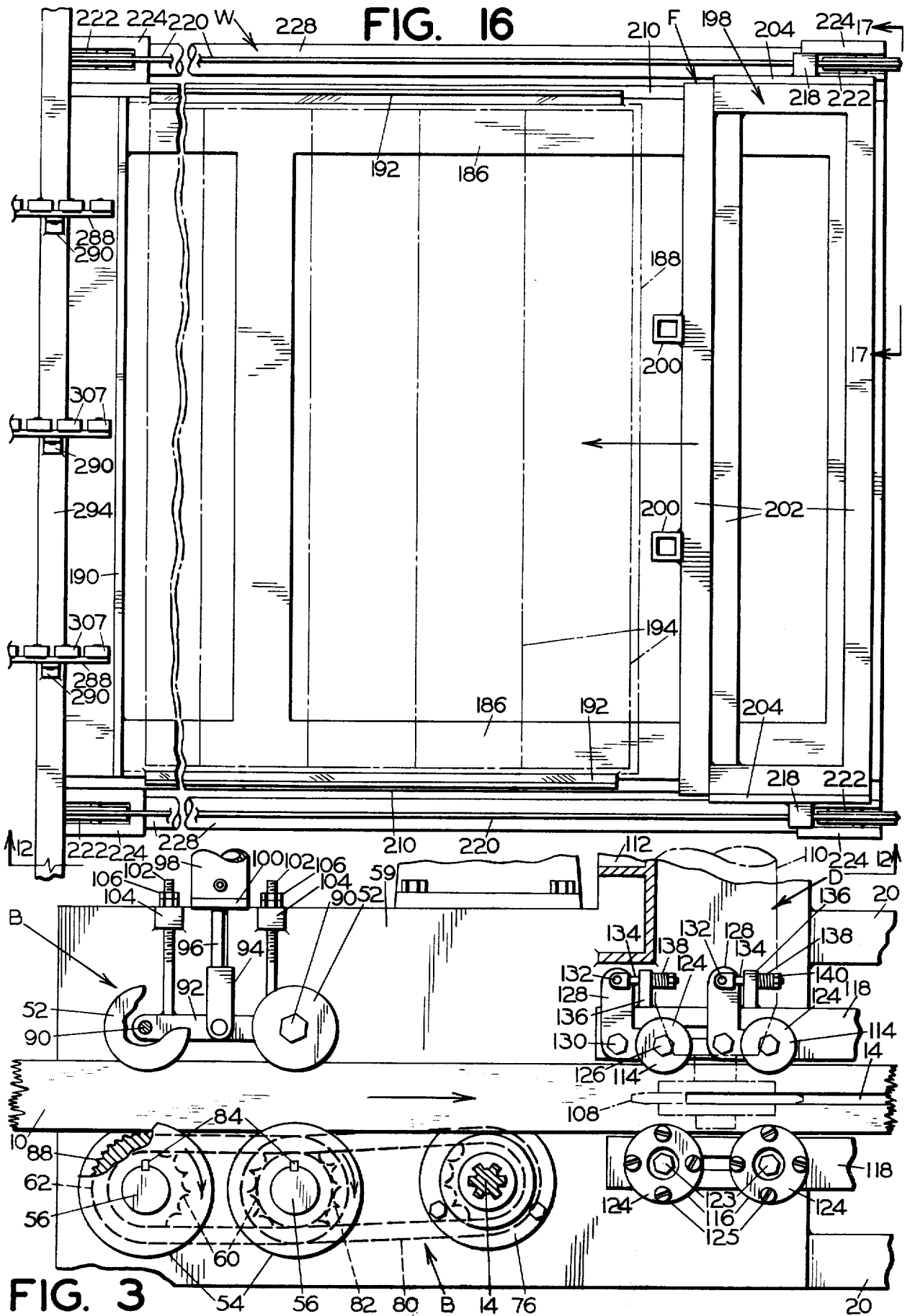


FIG. 19

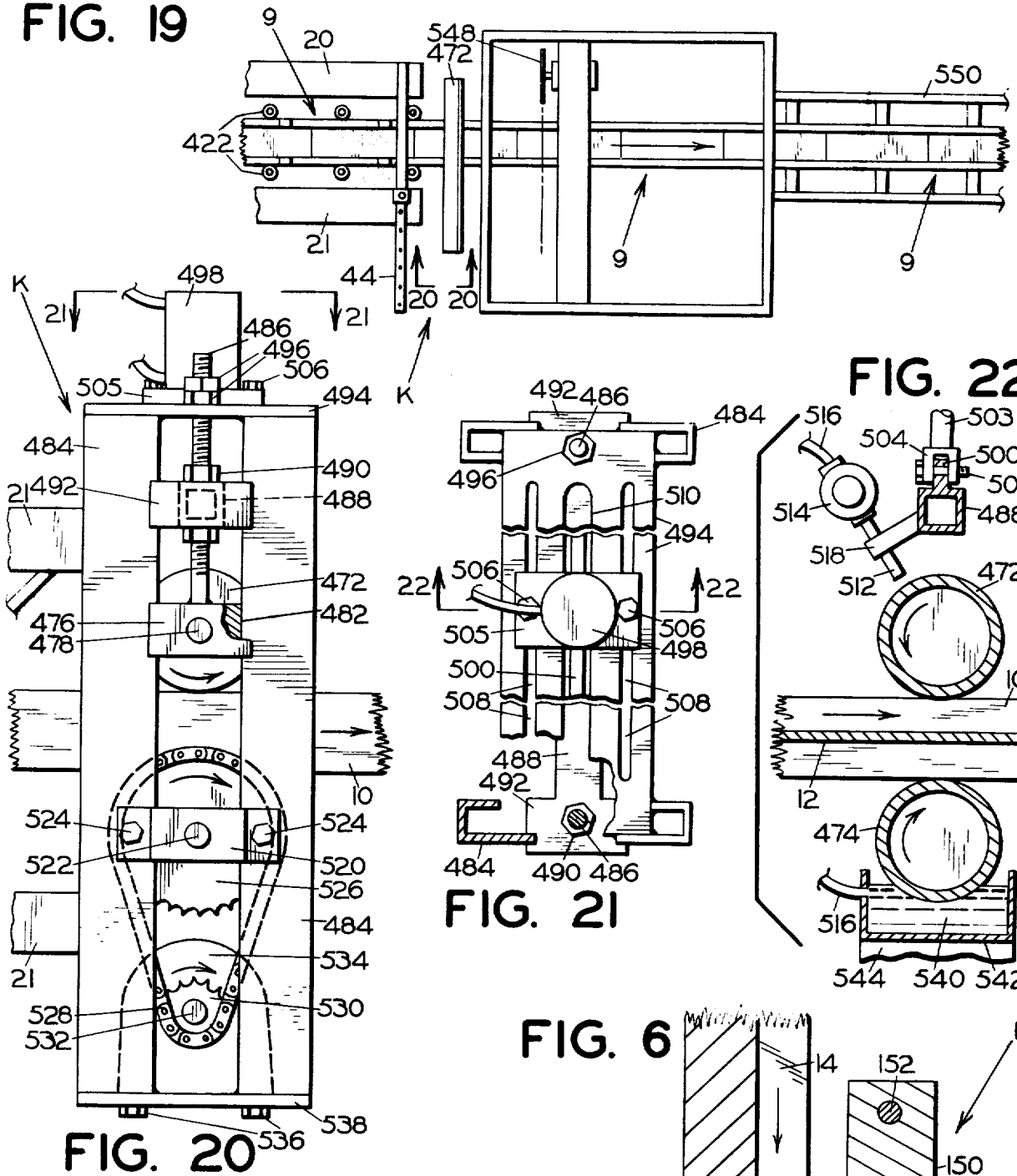


FIG. 22

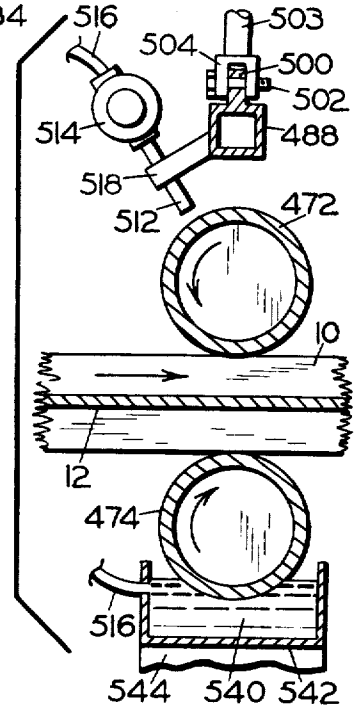


FIG. 21

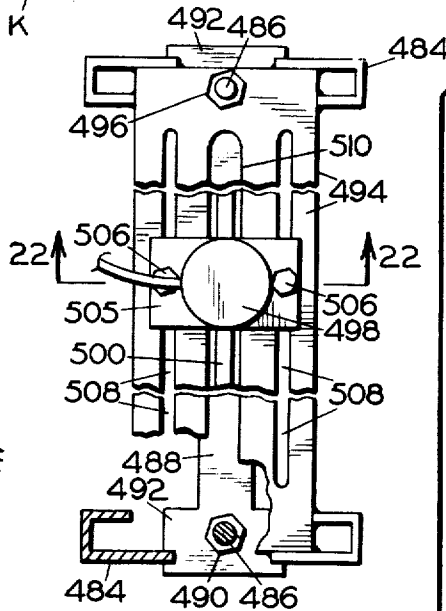


FIG. 6

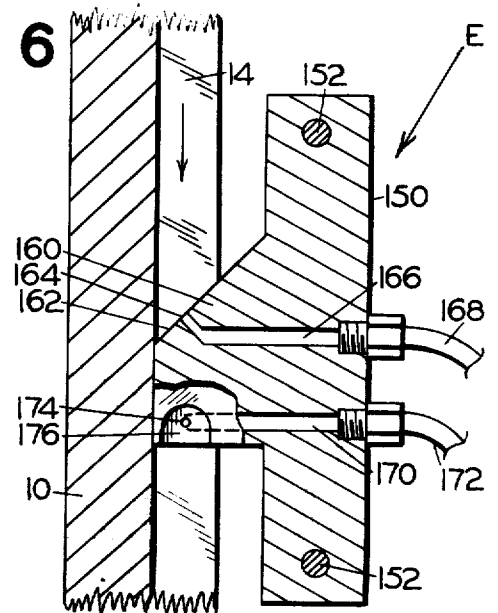


FIG. 7

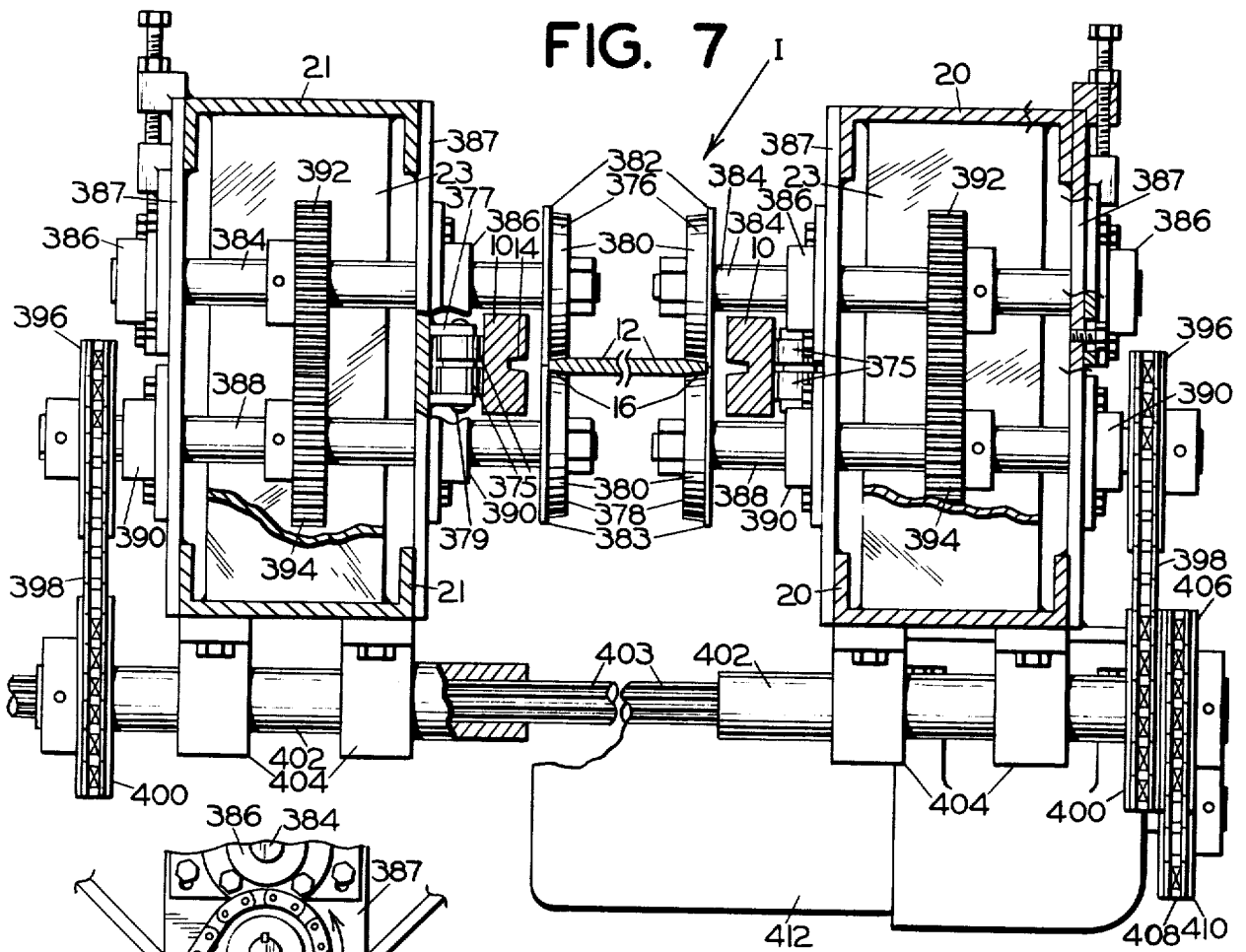
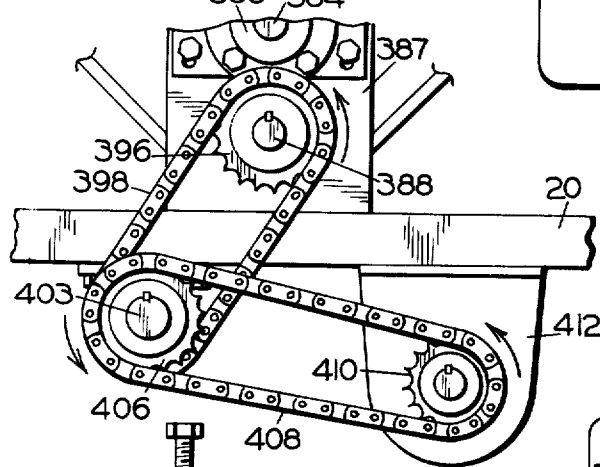
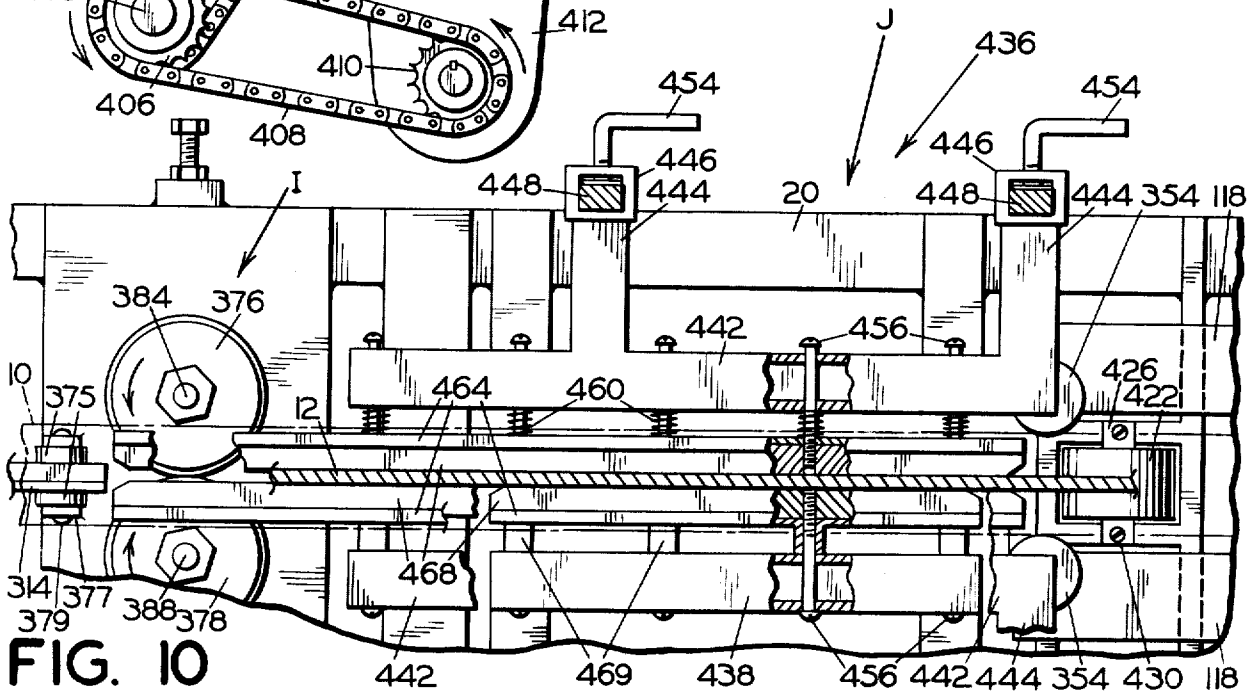
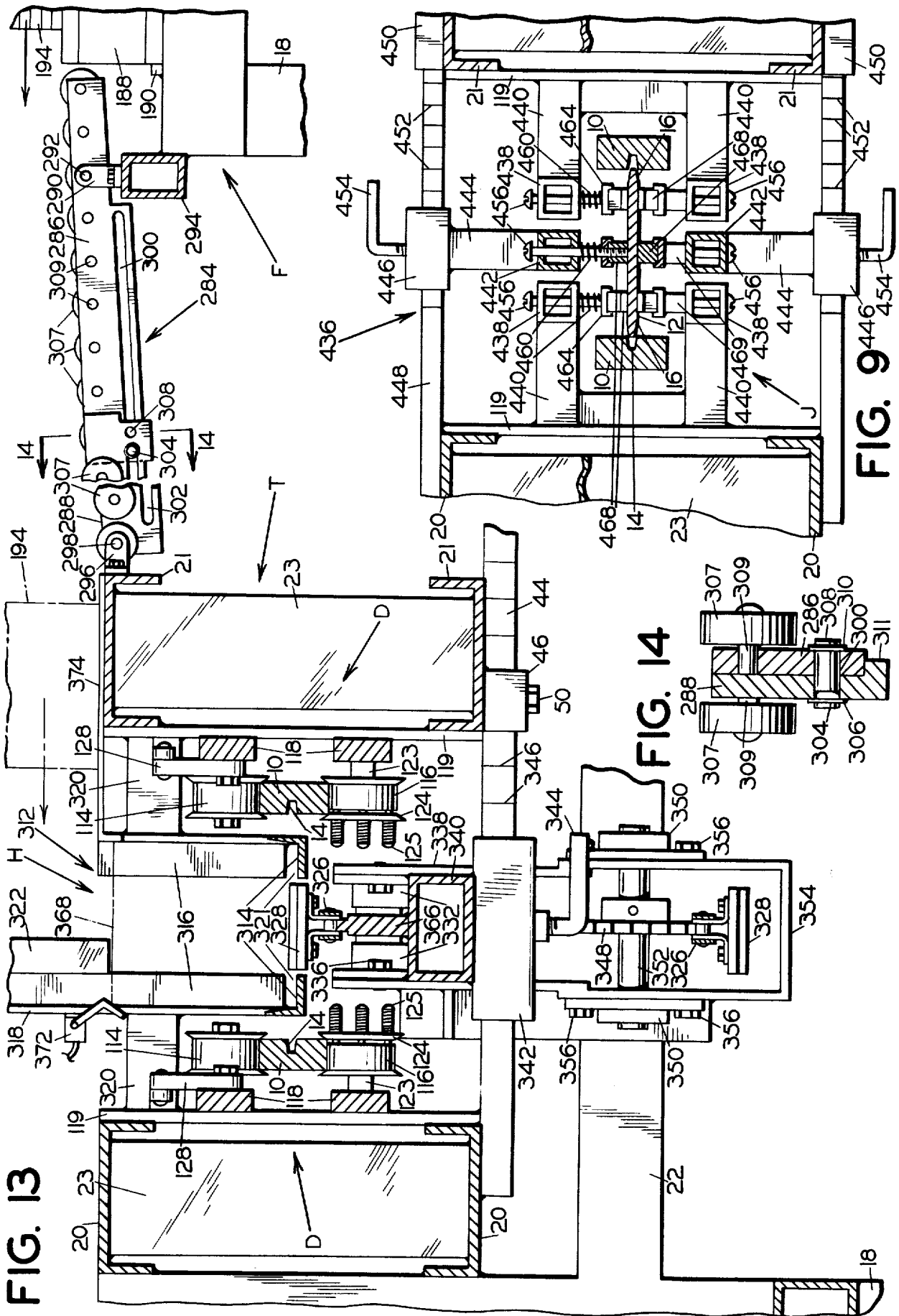
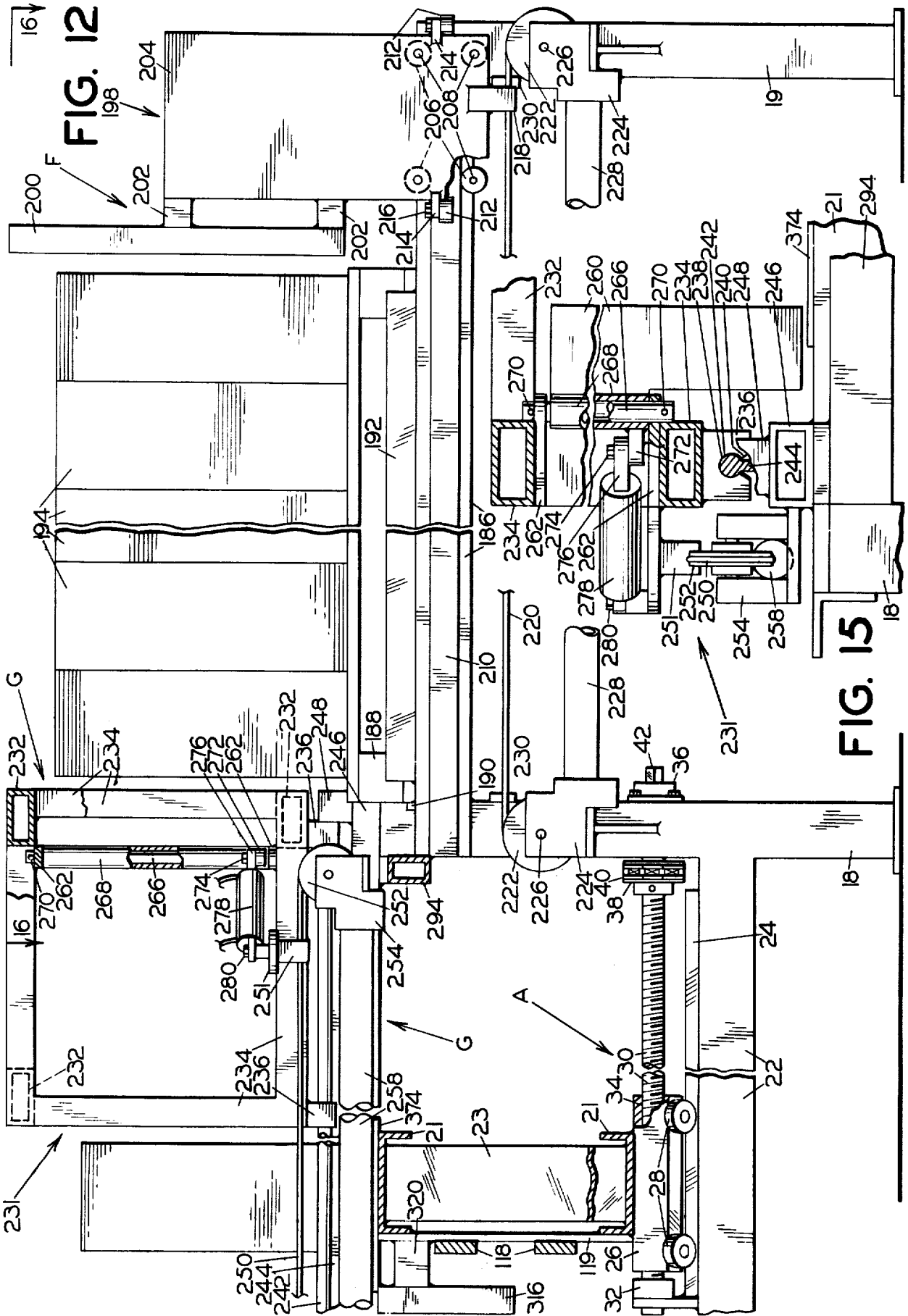


FIG. 8







# I-BEAM TYPE TRUSS JOIST FORMING APPARATUS WITH AUTOMATED WEB INFEED

## BACKGROUND OF THE INVENTION

This invention relates to the manufacture of I-beam type truss joists comprising a pair of chords or flanges and an interconnecting web. It pertains particularly to I-beam type truss joists having wooden components.

Troutner U.S. Pat. No. 3,616,091 describes apparatus for manufacturing I-beam truss joists of the foregoing class. The apparatus basically comprises chord feed means arranged to move a pair of chords longitudinally in laterally spaced relation with two sides thereof facing each other. Cutters are mounted adjacent the infeed end of the apparatus for cutting longitudinal grooves in the opposed side faces of the chords.

Web feed means downstream from the cutter means receives flat web members between the grooved chords. Shaping wheels are positioned for engaging the side margins of the webs for compressing them to a beveled contour matching the tapered groove contour in the chords. A glue applicator is positioned for applying glue to the beveled web margins.

Associated chord guiding and positioning means guides the chords against the webs, wedging the beveled margins of the latter into the grooves of the former. Holding means is arranged for holding the webs and chords in their assembled relation pending spring-back of the compressed margins of the webs with resultant application of bonding pressure to the joint.

The foregoing apparatus is particularly applicable to the forming of I-beam type truss joists from webs comprising pieces of plywood and chords comprising 2×4's or other dimension lumber. The chords also advantageously may comprise lengths sawn from billets comprising the laminated products resulting from the gluing together of sheets of wood veneer in accordance with the procedure set forth in Troutner U.S. Pat. No. 3,723,230.

While the foregoing apparatus and the procedure using it have met with substantial commercial success, nevertheless there remain areas of operation wherein certain difficulties have been encountered.

It accordingly is the general object of the present invention to provide apparatus for forming I-beam type truss joists from wooden chords and webs which is adaptable to the large scale manufacture of such products at competitive prices, and which is characterized by the inclusion of the following improved features:

1. A frame of sophisticated design enabling adjustment to accommodate webs and chords of varying dimension thereby making possible the production in a single machine of joists of assorted sizes.
2. An automated unit for feeding the webs to the production line.
3. Improved side and top guides for the chords.
4. Improved crimping means for compressing and beveling the side edges of the webs.
5. Means for applying constant and adjustable pressure on all the elements of the work during the entire processing operation.
6. Inclusion of applicator means for applying a glue repellent to the finished I-beam product, thus preventing sticking together of adjacent I-beams in a finished stack thereof.

## SUMMARY OF THE INVENTION

The foregoing and other objects of the invention are accomplished by the provision of apparatus for forming wooden chords and webs into I-beam type truss joists which comprises in combination chord feed means for moving a pair of chords initially in spaced relation greater than the overall width of a web, cutter means positioned for making grooves in the opposed faces of the chords, glue applying means arranged for applying glue to the grooves, automated web feeding means for feeding a web into the area between the two chords in the plane of the grooves, and chord guide means for guiding the chords against the margins of the web thereby, engaging the edges of the chord in the grooves.

Improved forming means press the web margins into a beveled contour. Adjustable frame means mount the processing units for adjustment as required to accommodate chords and webs of varying dimension. Guiding and positioning elements guide the joist components into proper assembling relation to each other.

Pressure applying means applies a constant and adjustable pressure to the work, thereby maintaining them in proper relation to each other during all processing operations.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1a is a side elevation of the presently described I-beam type truss joist forming apparatus, partly in section and with parts broken away for convenience of illustration, taken along line 1a, 1a of FIG. 2a.

FIG. 1b is a continuation of FIG. 1a taken along line 1b, 1b of FIG. 2b.

FIG. 2a is a plan view of the infeed end of the apparatus with parts broken away for convenience of illustration.

FIG. 2b is a continuation of FIG. 2a.

FIGS. 3, 4 and 5 are fragmentary sectional views taken along lines 3—3, 4—4 and 5—5, respectively, of FIG. 2a.

FIG. 6 is a fragmentary, plan, sectional view taken along line 6—6 of FIG. 5.

FIG. 7 is an enlarged, foreshortened, sectional view taken along line 7—7 of FIG. 2b, parts being broken away better to show interior construction.

FIG. 8 is a fragmentary elevation taken along line 8—8 of FIG. 2b.

FIGS. 9, 10 and 11 are enlarged, fragmentary, sectional views taken along lines 9—9, 10—10 and 11—11, respectively, of FIG. 2b.

FIG. 12 is a fragmentary, foreshortened sectional view taken along line 12—12 of FIG. 16, parts being broken away for convenience of illustration.

FIG. 13 is an enlarged, foreshortened, fragmentary, sectional view taken along line 13—13 of FIG. 2a.

FIG. 14 is an enlarged sectional view taken along line 14—14 of FIG. 13.

FIG. 15 is an enlarged, fragmentary, foreshortened view taken along line 15—15 of FIG. 2a.

FIG. 16 is a fragmentary, foreshortened plan view taken along line 16—16 of FIG. 12.

FIG. 17 is a fragmentary, foreshortened, elevation taken along line 17—17 of FIG. 16.

FIG. 18 is an enlarged, fragmentary section taken along line 18—18 of FIG. 2b.

FIG. 19 is a diagrammatic, fragmentary plan view of the outfeed portion of the apparatus.

FIG. 20 is a fragmentary enlarged elevation taken along line 20—20 of FIG. 19.

FIG. 21 is a foreshortened plan view taken in the direction of the arrows of line 21—21 of FIG. 20 with parts broken away for convenience of illustration.

FIG. 22 is a fragmentary section taken along line 22—22 of FIG. 21 and

FIG. 23 is an end view of an I-beam type truss joist which is the product of the operation of the present apparatus.

#### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The end product of the operation of the hereindescribed I-beam type truss joist forming apparatus is illustrated in FIG. 23. Indicated generally at 9, it comprises a pair of elongated chords or flanges 10 and an interconnecting web 12. Chords 10 have tapered grooves 14 in their opposed faces and web 12 has tapered side edge portions 16 engaged in the grooves. A glue connection is provided between the grooves and web side edge portions 16. The web 12 is provided in segments either in glued abutment or in spaced relation to each other to suit the needs of a particular purpose.

As noted above, chords 10 may comprise lengths of dimension lumber or lengths of laminated lumber manufactured by gluing together sheets of wood veneer to the desired thickness and then sawing the resulting billet to the desired width and length. Web 12 may comprise pieces of plywood of the desired dimensions glued end to end and having side margins crimped or compressed to the desired tapered tongue configuration.

The present apparatus incorporates means for manufacturing the joists shown in FIG. 23. With reference to FIGS. 1 and 2, the apparatus basically comprises, listed in downstream relationship to each other:

- A frame having a lateral adjustment subassembly indicated generally at A;
- A chord infeed drive indicated generally at B;
- A groove cutting subassembly for the chords, indicated generally at C;
- A vertical press roll assembly for the chords indicated generally at D;
- A glue applying subassembly for the web margins, indicated generally at E;
- A first stage web infeed subassembly indicated generally at F;
- A second stage web infeed subassembly indicated generally at G;
- A web-conveying subassembly indicated generally at H;
- A crimp wheel subassembly for compressing the web margins and shaping them into tongues, indicated generally at I;
- A chord and web uniting subassembly, indicated generally at J; and
- A subassembly for applying glue repellent to the finished joists, indicated generally at K.

Considering these various component subassemblies in greater detail and in the order named:

#### THE SUPPORTING FRAME

Referring to FIGS. 1, 2 and 13, the frame which supports the apparatus of the invention includes a plurality of vertical legs 18 which support two pairs of longitudi-

nally extending, laterally spaced, parallel main frame members 20. Each of the latter comprises a pair of vertically spaced, oppositely directed channel members 21 interconnected and braced by means of diagonal webs 23. Cross frame members 22 interconnect and brace legs 18 at spaced intervals along the length of the apparatus.

One of the longitudinal main frame members 20, i.e. the left hand frame member as viewed in FIG. 13, is welded or otherwise fixed to legs 18. However, the companion main frame member 20 is mounted for lateral adjustment in order to make the apparatus adjustable laterally as required to produce I-beam products of assorted heights. The means by which this is accomplished is illustrated particularly at A in FIGS. 1a and 12.

As is apparent from a consideration of those figures, cross frame members 22 support integral V-ways 24. Integral support blocks 26 are bottom mounted on frame member 20. The blocks in turn mount two pairs of rotatably mounted support rollers 28. These bear against V-ways 24.

One end of a threaded shaft 30 is supported rotatably in a bearing 32 and passes through a threaded bore 34 formed within each support block 26. The upper or right hand end of shaft 30 is rotatably mounted and laterally secured in bearing 36.

A sprocket 38 meshing with a chain 40 is fixed to shaft 30. Chain 40 interconnects shaft 30 with one or more downstream shafts 30 so that all may be driven from a common power source. At least one of shafts 30 has a squared end 42 to which a suitably dimensioned wrench can be applied. This causes the shafts to rotate in unison, causing the right hand frame 20 to move laterally in a maintained parallel relationship with respect to left-hand frame member 20.

Means are provided for measuring the lateral adjustment thus accomplished and for locking the two frame members in a selected position of lateral adjustment. The means employed for this purpose is illustrated in FIGS. 1a and 13.

One of the ends of a pair of indexing cross bars 44 is integrated with the left hand frame member 20. The other of the ends of each cross bar is received and supported by an indexing block 46 mounted on the bottom surface of right hand frame member 20. The cross bar terminates integrally with one of legs 18 on the right hand side of the apparatus.

The cross bar has a series of spaced bores 48. An indexing bolt 50 is threaded through indexing block 46. The bolt is dimensioned to register with a selected one of bores 48 through the indexing cross bar.

Accordingly, with bolts 50 removed, right hand frame member 20 may be indexed in selected increments by the rotation of shafts 30. The indexing operation is carried on until indexing cross bars 44 register with selected bores 48. The bolts then are reinserted, thus locking the left and right handed frame members 20 in the desired lateral spacing.

#### THE CHORD INFEEED DRIVE

The drive which feeds the chords into the machine is generally similar to that disclosed in U.S. Pat. No. 3,616,091, aforesaid. It is indicated generally at B and illustrated particularly in FIGS. 1a, 2a and 3 of the drawings.

The chord infeed drive includes four pairs of cooperating flanged rollers **52** and **54**. There are two roller pairs on each side of the apparatus, disposed inwardly of side frames **20**.

The two pairs of bottom rollers **54**, one pair on each side, are drive rollers. The two pairs of top rollers **52**, one pair on each side, are idler pressure rollers. Drive rollers **54** are keyed to the ends of short cross shafts **56**, one pair on each side, which have journaled supports **58** on structural side plates **59** provided for the purpose.

Sprocket pairs **60**, one pair on each side, are keyed centrally to shafts **56** and are rotatably linked together by means of chains **62**, so that they may be driven in unison. The drive comprises a motor **64** having its shaft **66** connected to a drive sprocket **68**. The latter in turn drives chain **70**, the lower end of which is trained around a sprocket **72**. Sprocket **72** is fixed on the end of a splined cross shaft or drive shaft **74** supported in bearings **76**. The drive shaft mounts adjacent each of its ends, and within the structural framework of side frame members **20**, a sprocket **78**. Each of these sprockets engages and drives a chain **80** which in turn engages a sprocket **82** keyed to the adjacent shaft **56**, thereby driving the lower rollers **54**.

Since drive shaft **74** extends across the width of the apparatus, it is necessary that it be adjustable in length to accommodate relative lateral changes in position of side frames **20**, as described above. When making this adjustment, right hand shafts **56** and their associated sprockets are supported by and move with the right hand one of frame members **20**. Accordingly, they require no adjustment when the latter is moved to a new lateral position.

However, a set screw **86** is threaded into the hub of right hand sprocket **78**. Upon loosening the set screw, sprocket **78** may be moved along the drive shaft to its new position, after which set screw **86** again may be secured. This will position sprocket **78** properly in alignment with the companion elements of the chain and sprocket drive train.

To provide proper timing, provision is made for driving the chords at a controlled and uniform rate.

To this end, flanged drive rollers **54** have serrated peripheral surfaces **88** for gripping the chords as they move into the machine. Also, resilient pressure applying means is associated with flanged idler rollers **52** so that the latter are under a continuous resilient pressure exerted in the downward direction.

Idler rollers **52** are supported by a pair of horizontally inclined, inwardly disposed stub shafts **90**. The stub shafts are integral with a walking beam **92** which in turn pivotally is supported at its center line by a clevis **94** formed on the lower end of a shaft **96**.

Shaft **96** comprises the piston rod of an air cylinder **98** mounted on the top of frame member **20** by means of a bracket **100**. The cylinder is of the cushion type which, when actuated, urges the rollers resiliently downwardly against the upper surfaces of the chords.

Stop means is provided for limiting the downward travel of rollers **52** in order to facilitate the introduction of chords into the apparatus.

The stop means comprises a pair of threaded studs **102** welded to the upper surface of walking beam **92**, one on each side of clevis **94**. The studs extend upwardly through openings in a pair of limit blocks **104** welded to the outside face of plate **59**. A pair of lock

nuts **106** is threaded onto the ends of each of studs **102**. Hence by adjusting the position of the lock nuts the extreme lower limit of travel of rollers **52** when the apparatus is empty may be determined. This in turn facilitates feeding the chords into the apparatus.

#### THE GROOVE-CUTTING SUBASSEMBLY

The groove-cutting subassembly, indicated at C of FIGS. **2a** and **3**, is positioned a short distance inwardly of the infeed end of the apparatus, just downstream from the chord feeding subassembly B. It has for its function cutting the tapered grooves **14** on the inwardly facing or opposed surfaces of the two chords **10**. There are two such subassemblies, one positioned on each side of the apparatus and working on the adjacent chord.

Each of the groove cutting subassemblies comprises a rotary cutter **108** disposed in a horizontal plane and direct-driven by an upright motor **110**. The motor is supported adjustably on a bracket **112** mounted on the inner face of frame member **20**. The bracket **112** is designed in known manner, not illustrated, to allow for the vertical and lateral adjustment of the cutter. This in turn permits proper location and depth of the groove **14** cut in chord **10**.

#### THE CHORD VERTICAL PRESS ROLLER SUBASSEMBLY

Stationed at intervals along the length of the apparatus are vertical press roller subassemblies for the chords, indicated generally at D and illustrated in FIGS. **1**, **2**, **3** and **13**.

These have for their function exerting a downward rolling pressure on chords **10**, thus guiding the chords through the apparatus and aligning them accurately, particularly in close proximity to cutter heads **108** as the latter cut grooves **14** in chords **10**. This in turn enables the cutter heads to locate the grooves with the accuracy required for efficient assembly of the joists in the latter stages of operation of the machine.

The press roller subassemblies comprise vertically aligned pairs of rollers **114** and **116**. Two of such pairs are located on each side of the machine, inwardly of side frames **20**.

The supporting structure for the rollers is illustrated particularly in FIGS. **1a** and **13**.

Two pairs of opposed longitudinal bars **118** are mounted on two pairs of vertical frame plates **119**. The latter are integrated with the inner faces of frame members **20**.

Bars **118** are relatively adjustable vertically in order to accommodate the passage of chords of varying width. They accordingly are mounted on frame plates **119** by means of bolts **120** which pass through a selected one of a series of angularly aligned bores **121** through frame plates **119**. The bolts are also received in horizontal slots **122** formed within bars **118**.

The desired degree of lateral adjustment of the press rollers thus may be obtained by inserting the bolts in the appropriate ones of bores **122**. This allows for passage through the machine of chords **10** having different incremental vertical dimensions so that the horizontal center lines of the chords **10** will always be maintained substantially aligned with the horizontal center lines of frame members **20**.

The lower roller **116** of each roller pair is rotatably mounted on bar **118** in fixed position by means of a

shaft 123. The structure of the roller is such as to provide for automatic lateral adjustment to allow for thickness variations in the chords. Accordingly, the rollers include laterally shiftable side flanges 124. These are secured by spring-loaded, laterally projecting screws 125.

The upper pressure roller 114 of each pair is resiliently displaceable in a vertical plane to accommodate irregularities in the width of the chords. It is rotatably mounted on a stub shaft 126. The latter is integral with and supported by a bracket 128 which is pivotally mounted on the upper longitudinal bar 118 by means of a pivot bolt 130, FIG. 3.

Pivotally mounted to the upper end of bracket 128 by means of pin 132 is a threaded stud 134. This stud passes through a fixed arm 136 which in turn is integral with frame 118. It also mounts a compression spring 138 retained by an adjusting nut 140. Upper rollers 114 thus are continuously biased in the downward direction, while permitting vertical displacement as required to accommodate deviations in thickness of the chords.

#### THE GLUE APPLYING SUBASSEMBLY

The glue applying subassembly, indicated generally at E, has for its function the application of glue along the surfaces of grooves 14 in the chords, preparatory to inserting web members 12 in the grooves.

It comprises two units placed slightly downstream from cutters 108, one associated with each chord.

Each unit consists of two principal components: an air jet to clean out of the grooves the sawdust and shavings generated by the operation of cutters 108 and a glue applicator head designed to apply the glue to the surfaces of the cleaned grooves. These are illustrated particularly in FIGS. 2a, 4, 5 and 6.

Each glue applying unit comprises a head 150 supported on a pair of upright, elongated screws 152. The latter are threaded into horizontally aligned, horizontally adjustable mounting blocks 154.

The length of screws 152 is somewhat greater than the vertical dimension of head 150. The outwardly extending segments of the screws above and below head 150 accordingly are used as supports for compression springs 156 and 158. The latter provide a vertical floating adjustment of the heads as required to compensate for any minor irregularities in the placement of chord grooves 14.

Each head 150 has an outwardly projecting tongue 160. This is shaped to project into tapered groove 14 in the chord. As shown in FIG. 6, this tongue serves the dual functions of providing an air jet and a glue applicator head.

To this end tongue 160 has an angled leading portion 162 on the edge which is disposed toward the infeed end of the machine. An air jet outlet 164 projects through this angled leading portion. Outlet 164 communicates with a passageway 166 to which air under pressure is supplied from a suitable source through conduit 168. The air source operates continuously so that as chord 10 progresses through the machine, the air jet cleans sawdust shavings and any other foreign material from chord grooves 14.

The glue applicator head includes a glue passageway 170 fed by conduit 172, FIG. 6. Conduit 172 communicates with a glue reservoir containing a quantity of suitable glue. The latter preferably comprises a water based glue which, upon application to the wooden

chords and webs, will swell the fiber structure of the wood. This produces an internal clamping action which holds the chords and webs in assembled relation pending setting of the glue, as will appear hereinafter.

Glue passageway 170 communicates with a vertically disposed passageway 174 which in turn leads to recesses 176 provided in the upper and lower surfaces of the tongue. Upon the introduction of glue into passageway 170, it is transmitted continuously into passageway 174 and recesses 176 and accordingly is applied continuously to both side walls of groove 14 as the chord progresses past the head.

Provision is made for lateral adjustment of block 154, and hence of head 150, to accommodate variations in groove depth.

As shown particularly in FIG. 5, block 154 is supported by a pair of horizontally disposed threaded studs 178. These pass through bores formed within block 154. The studs have a substantially greater length than the horizontal width of the block.

The desired lateral adjustment thus is made possible by clamping the block between two nuts 182 threaded onto the studs. The outer ends of studs 178 are formed onto a right angle bracket 184 which in turn is integral with a plate 185 welded to channel frame member 21.

Since the passage of the chords through the machine is intermittent, it is desirable to provide means for discontinuing the glue feed whenever tongue 160 is not in engagement with the walls of a groove 14.

A limit switch 183 is mounted on one side of the machine just ahead of one of glue heads 150. The switch has a moveable arm projecting into the path of chord 10. It controls the source which supplies glue to the glue head. It functions in a manner such that glue is supplied to head 150 upon engagement of the switch by a chord. However, when the chord moves beyond the switch, the supply of glue is cut off.

#### FIRST STAGE WEB INFEED SUBASSEMBLY

The apparatus heretofore described serves the function of feeding the chords in parallel, relatively widely spaced relation to each other, cutting two longitudinal grooves in the opposed faces of the chords, cleaning the grooves and applying glue to them. There next is described apparatus for introducing into the machine, at a station downstream from the glue-applying subassembly, web members which are fed to a location between the spaced apart chords where they may be integrated into the I-beam structure.

The web members 12 introduced in this manner normally comprise plywood sheets cut to size and supplied in a selected one of several commercial thicknesses. In the alternative, however, they may comprise sheets of lumber, wood particle board, or other suitable structural material, preferably characterized by compressibility and spring back following the application and release of pressure.

Whereas the webs were fed to the apparatus manually in Troutner U.S. Pat. No. 3,616,091, referred to above, it is a primary feature of the presently described apparatus that the web members are fed automatically at an accelerated rate. This is accomplished in two stages. In the first stage, indicated generally at F, the webs in large number are stockpiled in a plurality of stacks, their end surfaces coated with liquid glue, and advanced into working position for feeding into the machine.

In the second stage, indicated generally at G, the stacks are moved individually into feeding position and the component webs fed one at a time between the spaced, moving chords.

The frame which supports the first and second stage web infeed subassemblies includes legs 19 which support the right hand ends of a pair of longitudinally spaced frame members 186, FIGS. 12, 16 and 17. These frame members extend substantially at right angles to the line of travel of the chords. Their left hand ends are supported by legs 18.

Frame members 186 are positioned and arranged to mount a pallet 188. The pallet is located in precise working position by means of a transverse stop 190 and a pair of angled longitudinal side guides 192 formed in the top of frame members 186, FIG. 17.

Pallet 188 supports a plurality of web stacks 194, arranged side by side in longitudinal progression. For convenience of operation, the web stacks and pallet are assembled in another location and deposited on frame members 186 by means of a lift truck. Once deposited, a coating of glue is applied to the end faces of the stacks. The glue employed comprises a liquid glue having an assembly time sufficient to permit at a later time the webs to be assembled between the chords in edge-abutting lineal relationship, whereupon the glue applied to the web edges sets and thus joins the webs end to end.

The first stage infeed drive comprises a carriage indicated generally at 198 which mounts a ram positioned for pushing the stacks of web members in the feed direction along the surface of pallet 188, FIGS. 2a, 12, 16 and 17.

The ram includes a pair of spaced vertical pusher bars 200 integral with longitudinal frame members 202. The latter are supported by and bridge a pair of side plates 204.

The carriage thus comprised moves on two pairs of guide rollers 206 rotatably mounted on stub shafts 208. The latter in turn are mounted on the inner faces of the lower margins of side plates 204. The rollers are spaced vertically in pairs to register with and track on the top and bottom surfaces of a horizontally disposed pair of tracks 210 supported on the upper surfaces of frame members 186.

Pairs of horizontally arranged stabilizing rollers 212 are rotatably mounted on laterally extending ears 214 by means of shafts 216. Ears 214 are formed integrally upon both lower side edges of end plates 204 and are located in such a manner as to position rollers 212 to register with and track on the outer faces of tracks 210, thereby stabilizing the carriage assembly.

The ram-mounting carriage 198 is driven by an assembly including anchor blocks 218 located on the bottom of carriage end plates 204, one on each side. Blocks 218 provide anchors for drive cables 220 which are trained around pairs of longitudinally spaced idler pulleys 222. The latter are rotatably mounted on support brackets 224 by means of pins 226. Brackets 224 are mounted on leg structures 18, 19 and are bridged by power air cylinders 228, one on each side.

Each cylinder is of the class having a floating reciprocating piston to which the ends of one of cables 220 are attached. It accordingly provides a reciprocating drive for the cable which, in turn, is transmitted through anchor blocks 218 to the carriage. The limits of carriage travel are determined by a pair of stops 230,

one on leg 18 and the other on leg 19, positioned in the path of travel of the carriage anchor block 218.

Also associated with the first stage web infeed subassembly is a gravity conveyor having for its function the transmission of web stacks 194, one at a time, from the first stage to the second stage web infeed subassemblies. The gravity conveyor is indicated generally at 284 and is illustrated in FIGS. 2a, 2b, 13, 14 and 16.

To accommodate the lateral expansion of the machine as required to process I-beams of various dimensions, the gravity conveyor is of such a construction as to be longitudinally expandable. It consists of a pair of laterally extending, longitudinally-spaced, slidable bars 286 and 288. The bars are formed in two segments. The infeed segments of bars 286 are pivotally secured to a pair of brackets 290 by means of pins 292, FIG. 13. Brackets 290 in turn are fixed to the tops of a longitudinal sub frame 294 integral with leg structure 18.

The outfeed segments of bars 288 are pivoted to a pair of brackets 296 by means of pins 298. Brackets 296 in their turn are fixed to channel 21 of laterally moveable frame 20.

Both pairs of bars 286 and 288 have formed on their bottom portions cooperating longitudinal slots 300, 302. The outfeed segments of bars 286 have integral outwardly disposed stub shafts 304 which pass through slots 302 and are retained by clips 306, FIG. 14. The infeed end segments of bars 288 have integral, inwardly disposed horizontal stub shafts 308 which pass through slots 300 and are retained by clips 310.

An integral shoulder 311 is formed along the bottom margin of each bar 288. The shoulder bears against and supports the bottom edge of the companion bar 286.

The above structure provides a central truss support while at the same time allowing for the adjustment of right hand longitudinal frame member 20 as heretofore described. Bars 286, 288 mount along their entire lengths a series of closely spaced rollers 307. The rollers are mounted rotatably by means of stub shafts 309 and are dimensioned and arranged in such a manner that their upper peripheral surfaces extend slightly above the planes of bars 286, 288.

Gravity conveyer 284 discharges onto an aligned skid plate 374 supported by laterally adjustable, right hand longitudinal frame member 20. The infeed side of conveyer 284 is elevated slightly higher than at the outfeed side. Consequently, when a stack 194 of webs is pushed by ram carriage 198 onto the conveyer, the stack will be propelled by gravity along the entire length of the conveyer, coming to rest eventually on skid plate 374.

## THE SECOND STAGE WEB INFEED SUBASSEMBLY

The second stage web infeed subassembly has for its function transferring the individual stacks 194 of web members from their ready position on skid plate 374 to a bin located in working position between the grooved chords 10. The web members then are dispensed from the bin one at a time and assembled with the chords in a manner to be described.

The second stage web infeed subassembly, indicated generally at G in the drawings, is illustrated in FIGS. 2a, 2b, 12, 13 and 15.

Basically considered, the second stage web infeed subassembly comprises a web stack advancing carriage which sweeps a web stack 194 along the upper surface of skid plate 374, and a dispensing bin positioned to re-

ceive the stack and dispense its component webs individually from the bottom of the stack.

As shown particularly in FIGS. 12 and 15, the web stack advancing carriage, indicated generally at 231, includes cross frame members 232 bridging a pair of rectangular end frames 234. The frame thus comprised is supported on blocks 236 which provide slides for reciprocating the carriage between advanced and retracted stations.

To this end blocks 236 have formed within them longitudinal bores 238 with connecting slots 240 which communicate with the exterior.

Blocks 236 are guided by a pair of laterally spaced, horizontal rails 242 having integral supporting webs 244. The webs are supported on the tops of frame members 246 which in turn are integrated with the leg frame structure 18. Rails 242 are received slidably in bores 238 of support blocks 236 while webs 244 are received in slots 240 of the blocks, thereby permitting the sliding reciprocation of the carriage on the rails.

Stop means are provided for stopping and properly locating the carriage at its advanced and retracted stations. The stop means employed comprises stop blocks 248 integrated with structural frame members 246 and positioned for abutment with the carriage frame at the end positions of carriage travel.

The reciprocating drive for web stack advancing carriage 231 comprises a pair of drive cables 250 secured to brackets 251 which are supported on carriage frames 234. Cables 250 are trained around idler pulleys 252 supported on frame members 254. The latter in turn are supported by and integral with leg frame structure 18.

The drive for the carriage comprises a pair of double acting air cylinders 258. These are mounted on and bridge frame members 254, one on each side of the unit. Like cylinders 228 they are conventional in construction, being of the class having a free floating, air driven piston to which the ends of cables 250 are connected.

Carriage 231 supports pushing or sweeping means which, during the advancing motion of the carriage, engages the ready stack 194 of webs waiting on skid plate 374 and slides it along the plate until it is discharged into the web dispensing bin. The construction of this unit also is illustrated particularly in FIGS. 12 and 15.

A pair of cooperating, retractable, web stack pusher plates 260 are supported in a vertical operating position on pairs of vertically spaced ears 262. The latter are integral with the inner portions of carriage end frames 234.

Pusher plates 260 are mounted for angular movement in the horizontal plane by providing in ears 262 bores through which pass the ends of pivot posts 266. The pivot posts mount sleeves 268 to which pusher plates 260 are welded. Cross pins 270 at both ends of the posts retain the plates.

To drive pusher plates 260 between their advanced and retracted angular positions, sleeves 268 mount horizontally extending tabs 272. Pivot pins 274 pivotally connect to tabs 272 the extendable operating members 276 of pneumatic cylinders 278. The bases of the cylinders are pivotally connected by means of pins 280 to the frame of the carriage, specifically to a plate carried by cable anchor block 251, FIG. 12.

As noted above, carriage 231 operates to discharge a stack of webs into a web dispensing bin from which

the webs are fed between the traveling grooved chords. The bin is indicated generally at 312 and illustrated particularly in FIGS. 1, 2 and 13.

Bin 312 is located along the longitudinal center line between main frame members 20. It consists of spaced, longitudinal, web bottom supports 314. These support four corner posts 316. The left hand posts 316 extend into upper portions 318.

The bin frame thus constituted is supported rigidly by four integral support arms 320. These extend laterally outwardly from, and are welded to, vertical support plates 119.

The upper frame portions 318 have integral outwardly extending webs 322 to provide additional guiding means for the incoming web stack 194.

The webs contained in the bin are dispensed individually from the bin bottom through slots 321 provided by notches in corner posts 316. The slots have a vertical dimension slightly greater than the thickness of one of webs 12. This permits passage of the web through the slot while retaining the balance of web stack 194 in the bin.

#### THE WEB CONVEYING SUBASSEMBLY

The web conveying apparatus is located directly below bin 312 along the longitudinal center line of the machine. It serves the functions of dispensing the webs from the bin by scraping them off the bottom of stack 194, one at a time, and conveying them in timed, positioned sequence to the downstream processing units of the machine.

Indicated generally at H, the web conveying subassembly is illustrated particularly in FIGS. 1, 2 and 13. It consists of an endless chain 326 having attached thereto evenly spaced, web-engaging lugs 328.

The top run of chain 326 is supported by two idler sprockets 330. These in turn are supported by pairs of bearings 332 on cross shafts 334.

The mounting of the chain assembly is such that it may be adjusted laterally, as may the other units of the machine, to accommodate webs of varying width in the construction of I-beams of assorted sizes.

To this end bearings 332 are bolted to brackets 338 by means of bolts 336. Brackets 338 are integral with longitudinal frame elements 340. These in turn support a pair of sleeves 342 secured to the underside of both ends of frame elements 30.

Cross bars 44 pass through and adjustably support sleeves 342. A threaded indexing clamp 344 releasably locks sleeves 342 to the cross bars. Indexing lines 346 on the surface of bars 44 facilitate the proper lateral positioning of chain 326.

The infeed end of the bottom run of chain 326 is guided by an idler sprocket 348 rotatably supported by bearings 350 into which cross shaft 352 mounting the sprocket is journaled. Bearings 350 are adjustably mounted to a U-shaped bracket 354 by means of bolts 356. The bolts are received in slots 358 formed within bracket 354, FIG. 1a.

The legs of bracket 354 extend upwardly and are welded to the underside of longitudinal frame 340.

The outfeed end of chain 326 is guided by drive sprocket 360 fixed to the shaft 364 of a gear motor 362. The motor is detachably mounted on frame 340. The chain is additionally supported by a longitudinal bar 366 on which tracks the upper run of the chain, FIGS. 1a and 13.

The chain drive is controlled by means of a travel limit switch (not illustrated) which energizes drive motor 362 as required to move lugs 328 in stepped sequence. During each step, one of lugs 328 engages the lowermost web in bin 312, drives it out of the bin, and to the next processing stage. The chain drive then stops with the next lug 328 in operative position with respect to the next web 12, awaiting the signal which will initiate the next step of the chain drive.

As the sequence progresses and the web stack in bin 312 diminishes to the broken line position 368 of FIG. 13, a sensing switch 372 signals for the introduction of a new stack 194 of webs to be introduced into the bin.

#### THE CRIMP WHEEL SUBASSEMBLY

The crimp wheel subassembly, indicated generally at I, serves dual functions.

It receives the webs urged forwardly one at a time by conveyer 324 and continues to drive them at a controlled rate predetermined to abut their end edges and crowd them together. This facilitates setting of the glue applied to the end edges while the webs were stacked on the first stage web infeed subassembly F.

The crimp wheel subassembly also serves the function of compressing the side margins of each web to form beveled marginal tongues 16 which subsequently are inserted into the glue-moistened grooves 14 of the chords to unite the three components of the I-beam assembly.

The construction and manner of operation of the crimp wheel subassembly is illustrated particularly in FIGS. 2b, 7, 8 and 18. The crimp wheels are indicated at 376 and 378. They are arranged in vertically aligned pairs and have a vertical spacing such as to grip the side margins of web 12, as best seen in FIG. 18. They not only drive the web toward the outfeed apparatus, but also shape its side margins.

To this end the peripheral edges 380 of crimp wheels 376 and 378 are beveled in the desired contour for shaping the web margins. They thus compress the wood to provide tapered margins or tongues 16.

To limit the converging pressures acting on the web margins, crimp wheels 376 and 378 are provided with coplanar integral flanges 382, 383, respectively. In the operation of the crimp wheels, they contact each other and act as stops, limiting the degree of compression of the wood.

The drive for the crimp wheels is illustrated particularly in FIGS. 7 and 8.

Upper crimp wheels 376 are supported on shafts 384 having journal support in bearings 386. The latter are adjustably secured to frame plates 119, 387.

Lower crimp wheels 378 are supported on shafts 388 having journal support in bearings 390. These are detachably mounted to frame plates 119, 387.

Shafts 384 and 388 mount pairs of meshing gears 392, 394, respectively. The outer ends of shafts 388 mount drive sprockets 396. These in turn engage a pair of drive chains 398 which mesh with a pair of sprockets 400.

Sprockets 400 are carried by internally splined sleeves 402 rotatably supported by two pairs of bearings 404.

As with the other elements of the apparatus, provision is made for lateral extension of the crimp wheel subassembly drive as required to accommodate webs of various widths.

Accordingly, there is provided a splined drive shaft 403 which is received by and drives internally splined sleeves 402. Shaft 403 is integral with the right hand sleeve 402 but is free to move longitudinally within the left hand sleeve 402, making possible the desired lateral adjustment.

The right hand end of the right hand sleeve 402 mounts a second sprocket 406 which is fixed to sprocket 400. Sprocket 406 meshes with a chain 408 driven by a sprocket 410. The latter in turn is driven by the shaft of a gear motor 412 mounted on the undersurface of main frame member 20.

#### THE CHORD AND WEB UNITING SUBASSEMBLY

Up to this point in the progression of the chord and web components through the various processing units of the apparatus, the components have been maintained laterally spaced from each other. As the components pass through the crimp wheel station, FIG. 7, the horizontal spacing still is maintained. However, the crimp wheels position the web with its marginal tongues 16 in precise horizontal alignment with grooves 14 of the chords.

In the next processing stage, the web movement is continued linearly in the machine direction. However, the chords are guided inwardly toward the web until the tongues of the web enter the glue-moistened grooves of the chords.

Since the chords and webs comprise structural members of great strength and stiffness, a substantial effort is required to achieve this result. This effort is resisted by the chords and webs with the result that, in the absence of properly applied restraining forces, the chords tend to back away from the web in the horizontal plane and the web tends to bow in the vertical plane. These adverse tendencies, if permitted freedom, would cause the tongues of the web to pop out of the grooves of the chords at intervals along the length of the assembly, resulting in the formation of discontinuous joints.

It accordingly is the function of the chord and web uniting subassembly to guide the chords into assembling relation with the web, to maintain the web and chords in precise relation to each other as they are assembled, and to maintain the web and chords in their assembled condition until a semi-permanent union has been created.

This union is created partly by the wedging action of the mating beveled surfaces of the web tongues and the chord grooves; partly by the spring back forces exerted by the crushed wood of the web marginal tongues; and partly by incipient bonding of the glue applied previously to the chord grooves by glue-applying subassembly E.

The chord and web uniting subassembly comprises a group of cooperating roller and guide bar assemblies indicated at J in the drawings and illustrated in detail in FIGS. 1b, 2b, 7, 9 and 11.

The roller assemblies locate the chords in both vertical and horizontal planes; the guide bar assemblies prevent bowing of the web.

Positioned upstream and downstream from crimp rollers 376 and 378, and immediately adjacent thereto, are vertically arranged pairs of guide rollers 375, 416. These stabilize and guide the joists as they pass through the crimp rollstation. Rollers 375 bear against the outside faces of the chords while rollers 416 bear against the inside faces thereof. The latter rollers thus serve as

fulcrums about which the chords bend as they converge toward the webs, FIG. 2b.

Rollers 375 are supported on brackets 377 and are rotatably mounted on vertical stub shafts 379, FIG. 7.

Rollers 416 are supported on brackets 418 and are rotatably mounted on vertical stub shafts 420. The brackets are secured to the inner faces of frames 20.

Positioned downstream from rollers 416, toward the outfeed section of the apparatus, are a group of rollers 422. These are illustrated in FIGS. 1b, 2b, 11 and 19. They bear against the outer side faces of the chords and guide the chords into wedging engagement with the side margins of the webs, thereby causing the tongues of the webs to enter the grooves of the chords.

Rollers 422 are supported on brackets 424 and are rotatably mounted on vertical stub shafts 426. The brackets are integral with and mounted on the inner faces of frames 20. They include pairs of horizontal support members 428 to which stub shafts 426 are secured by means of bolts 430 penetrating flat terminal segments of the shafts, FIG. 11.

Cooperating at the chord and web joining station with horizontally acting roller pairs 422 which bear against the side faces of the chords, are a plurality of vertically acting roller pairs 434 which bear against the edge surfaces of the chords.

Rollers 434 are supported on two pairs of longitudinally disposed mounting bars 432. These are similar in design and manner of attachment to mounting bars 118 previously described, FIG. 1b. These rollers are rotatably mounted and supported on bars 432 in the same manner as rollers 114 are mounted on bars 118, previously described.

The guide bar assemblies prevent bowing of the webs and position their beveled side margins accurately with respect to the grooves of the chords. They are indicated generally at 436 and illustrated particularly in FIGS. 2b, 9 and 10.

One guide bar assembly is positioned above and the other below the web in mutually opposed cooperating relationship.

Each assembly includes three guide bars, the left hand one being fixed to the stationary frame member 20, FIG. 9; the right hand one being fixed to laterally shiftable frame member 20; and the intermediate one being adjustable laterally so that it may be located along the longitudinal center line of webs of varying width.

The outermost guide bars 438 are supported by outwardly extending arms 440 which are welded to plates 119 carried by the respective frame members 20.

The intermediate or center line guide bars 442 are supported by a pair of longitudinally spaced, vertically extending support arms 444. These are rendered laterally adjustable by integrating them with horizontal sleeves 446 slidably mounted on horizontal indexing bars 448. They are relatively elongated in the infeed direction so that they closely approach the crimp rolls. This insures adequate web stabilization in an area where it is most needed.

The left ends of bars 448, FIG. 9, are integral with stationary frame 20. The right hand ends are received by guide sleeves 450 which are integral with laterally adjustable frame 20. Indexing lines 452 are marked on both bars 448. Clamping screws 454 make possible releasably clamping sleeves 446 to the bars at the selected index marks.

Guide bars 438, 442 support contact shoes which slidably engage the moving web. The upper contact shoes are resiliently mounted to accommodate the work; the lower shoes are fixed.

As shown particularly in FIGS. 9 and 10, upper guide bars 438, 442 slidably support a series of vertically disposed screws 456. The leading ends of the screws mount compression springs 460, pass through bores formed within longitudinal channels 464 and are threaded into aligned bores formed within longitudinal frictional guide shoes 468.

Guide shoes 468 bear against the work and are formed of a material such as "Teflon" or other plastic which is tough, wear resistant, and has a low coefficient of friction. The guide shoes are pressed resiliently against the surface of the work by compression springs 460 and are backed up by the longitudinal channel members 464.

The mounting of the lower group of guide bars 438, 442 is similar to that described above, with the exception that they are not resiliently mounted, spacers 469 being substituted in the assemblies for compression springs 460.

#### ADHESIVE-REPELLENT APPLICATOR SUBASSEMBLY

The chords and web leave the chord and web uniting subassembly K as an integrated I-beam type truss joist precursor which is sufficiently self sustaining to be passed to downstream processing units. Pending final curing of the glue which forms the bond between chords and web, and as part of subsequent processing procedures it may be expedient to stack or nest the joists in direct contact with each other.

This poses a problem, since occasionally excess glue may have been deposited on the top or bottom surfaces of the chords by operation of the glue applying subassembly E. More significantly, where the chords comprise sawn lengths of glue-lam timbers composited from glued together sheets of wood veneer, the glue applied in grooves 14 of the chords may ooze or seep through any voids which may be present in the veneer components of the chords and find its way to the chord surfaces. Accordingly, when the embryonic joists leaving the present apparatus subsequently are nested or stacked, their surfaces may become permanently and irrevocably glued to one another.

To avoid this possibility, the joists leaving the machine are passed through an adhesive-repellent applicator. This has for its function applying to side edge surfaces of the joist chords a quantity of an adhesive repellent which prevents the contacting surfaces of adjacent joists from sticking to each other. A variety of solutions may be used for this purpose. One class of such solution which is satisfactory is that comprising an aqueous emulsion or solution of mineral or vegetable wax.

The construction and mode of operation of the adhesive-repellent applicator subassembly K is illustrated in FIGS. 19, 20, 21 and 22.

As illustrated, this subassembly is contained in a frame located just downstream of the chord-and-web joining subassembly and comprises base plate 538; a pair of vertical side plates 484 on each end, horizontally spaced to form a central guideway; and a top plate 494 connecting the tops of the side plates.

This frame houses a pair of cooperating top idler and bottom powered rolls 472, 474, respectively. These

comprise liquid-applicator rolls, continuous across the width of the apparatus, and positioned to contact the top and bottom edge surfaces of chords 10 as required to apply liquid adhesive repellent to them.

To enable accommodating chords of varying width, top idler roll 472 is mounted rotatably for vertical adjustment.

To this end, both ends of roll 472 are rotatably supported by a pair of bearings 476 journaling stud shafts 478 which extend outwardly from the ends of the roll, coaxially therewith.

The bearings are provided with marginal vertical slots 482 which receive and are guided by the inner margins of end plates 484.

A pair of threaded studs 486 are vertically aligned along the center line of stub shafts 478. The lower ends of the studs are secured to the tops of the bearings 476. Their central portions pass through and support both ends of a crossframe 488 which is adjustably secured in a selected vertical position by means of pairs of clamping nuts 490.

Cross frame 488 is formed with T-shaped cross heads 492. The side margins of the cross heads are slotted and, like the side margins of bearings 476, receive the inner side margins of spaced side plates 484 in slide-and-guide relationship.

The upper ends of stud bolts 486 pass through openings in the ends of top frame member 494. A pair of lock nuts 496 are threaded to the upper portions of the stud bolts and limit the vertical position of roll 472, thereby imparting the desired vertical adjustability to the assembly.

Raising and lowering of roll 472 are accomplished by means of a centrally located air cylinder 498.

The connection of the cylinder to the roll, FIG. 22, is via piston rod 503 of the cylinder, a clevis 504 mounted as a head on the end of a piston rod, a vertical longitudinal web 500 extending upwardly from the upper surface of cross frame 488 and having a plurality of horizontally spaced perforations, and a bolt 502 received in a selected one of the perforations. Thus, raising and lowering the piston rod raises and lowers correspondingly roll 502, which thereafter is maintained gravitationally in precisely the selected position of adjustment by means of lock nuts 496.

It will be recalled that the right hand longitudinal frame member 20, as viewed in FIG. 2a, is adjustable laterally with respect to the companion left hand frame member 20, which is fixed. This is necessary in order to accommodate webs of varying width in the production of I-beam joists of assorted sizes. This requires that the adhesive repellent applicator subassembly K be correspondingly adjustable.

Accordingly, just as connecting clevis 504 mounted on piston rod 503 of the cylinder is positionable laterally, so is cylinder 498 shiftable to a corresponding position of lateral adjustment.

This is made possible by providing in top plate 494 a pair of marginal slots 508 and an intermediate slot 510, all arranged longitudinally of the plate and in substantial parallelism to each other.

The base of cylinder 498 is provided with a flange 505. This is adjustably secured to top plate 494 by means of bolts 506 passing through the flanges and slots 508. The piston rod 503 of the cylinder extends through central slot 510.

The desired lateral adjustment of the assembly then may be secured by removing pin 502 from clevis 504, FIG. 22, loosening bolts 506, sliding cylinder 498 and the attached assembly to its new location, reinserting pin 502 and tightening down on bolts 506.

Roll-moistening means is associated with upper roll 472 as required to maintain its peripheral surface moistened with adhesive repellent solution.

The roll-moistening means employed comprises a pair of liquid applying nozzles 512 mounted on cross frame 488, FIG. 22, by means of a bracket 518. Each nozzle is connected to a valve 514 which in turn communicates with a reservoir 542 by means of a conduit 516 with included pump. One such nozzle is positioned directly over the working areas of roll 472, above the upper surfaces of chords 10.

The left hand nozzle 512 as viewed looking in the machine direction, i.e. that illustrated in FIG. 22, is fixed. The right hand nozzle is mounted for lateral adjustment on cross frame member 488, in a manner not illustrated.

Thus to adjust the unit to accommodate joists of different widths, the fixed left hand nozzle 512 is located over the left hand chord 10. The shiftable right hand nozzle is moved until it registers with the right hand chord 10 after which it is secured.

Then to insure the application of uniform downward pressure on both ends of roll 472, bolt 502 is removed from clevis 504 and bolts 506 are removed from cylinder base 505. The cylinder with its attached piston rod 503 is shifted to the desired new location. Bolt 502 is reinserted through clevis 504 in the appropriate opening in web 500 of cross frame member 488. This secures the piston rod connection. The cylinder then is secured by tightening down on bolts 506 in the new location of the cylinder.

Like upper applicator roll 472, lower applicator roll 474 spans the entire width of the joist. Unlike the upper roll, however, its peripheral surface is moistened by direct immersion in reservoir 542, which serves as a source of supply for nozzles 512. Also, the lower roll serves as a drive roll which drives the joist through the outfeed portion of the apparatus at substantially the same speed as chords 10 are fed into the apparatus.

To accomplish these dual functions, both ends of roll 474 mount outwardly extending stub shafts 522. These are journaled in end bearings 520. The bearings are detachably mounted on end frame members 484 by means of bolts 524.

A sprocket 526 is fixed to the end of one of shafts 522 just inside frame 484 as shown in FIG. 20. Sprocket 526 engages drive chain 528 which at its lower end engages and is driven by a sprocket 530 fixed to drive shaft 532 of motor 534. The motor in turn is detachably mounted by means of bolts 536 to frame bottom plate 538.

The lower portion of the complete length of roll 474 is immersed in the adhesive-repellent solution 450, previously described, contained in the reservoir 542. The reservoir is mounted on supports 544 integral with frame bottom plate 538.

By this arrangement the bottom surfaces of chords 10 are continuously coated with glue repellent liquid by transfer of the liquid from the upper peripheral surface of roll 474 to the undersurfaces of the chords. Contemporaneously, the upper surfaces of the chords are coated with the liquid by transfer from the peripheral

surface of upper roll 472, which is continuously replenished with liquid in the area of the chords by spray nozzles 512.

The joists accordingly leave the apparatus in a self-sustaining condition with the side edges of the chords coated with an adhesive repellent. They then are conveyed to further processing.

Since the apparatus is adaptable to the production of continuous joists of great length, i.e. 80 feet or more in length, it may be desirable to subdivide them into shorter lengths, or to trim them to uniform length. If so, the chords may be passed through a conventional flying cut-off saw 548, FIG. 19. They then may be conveyed by a conveyor 550 to downstream stations where they are stacked, oven heated for completing the cure of the adhesive, nested, and packaged for storing and shipment.

### OPERATION

In the operation of the apparatus, chords 10 are fed continuously into the chord infeed sub-assembly B. Feed rollers 54 drive the chords forwardly at the machine speed. Hold down rollers 52 press the chords against the feed rollers to insure a uniform drive.

The chords maintained in laterally spaced apart relationship pass first through a groove cutting subassembly C, wherein cutters 108 machine beveled longitudinal grooves in the opposed side faces of the chords. The vertical chords press roller subassembly D holds the chords precisely in position to insure accurate cutting of the grooves.

The chords next pass through a glue applying subassembly E where glue applying heads 150 first direct a jet of air into the grooves to clean them out and then apply a liquid glue to the cleaned groove surfaces.

The chords next pass a station in which web members 12 are introduced into the space between the chords.

The webs are supplied to the apparatus in stacks 194, FIGS. 12 and 13. In the first stage web infeed subassembly F the stacks supported on a pallet 188 are precisely located on a horizontal support and their end faces manually coated with glue. A ram indicated generally at 198 pushes the stacks one at a time onto a skid plate 374 which is a component of the second stage web infeed subassembly G.

The latter subassembly comprises a carriage 231 provided with cylinder driven pusher arms 260 adjustable between open and closed positions. The stack is pushed by ram 198 between the frame components of carriage 231 with pusher arms 260 in the open position of FIG. 15. The arms then are closed, carriage 231 advanced, and the stack skidded forwardly on skid plate 374 into a bin 312. The bin is positioned between the traveling chords. There it is deposited on top of a partly diminished working stack.

Individual webs are scraped off the bottom of the stack in bin 312 by means of a web conveying subassembly H, FIGS. 2a and 13. The conveyor comprises a longitudinally disposed chain 326 mounting spaced lugs 328 which engage the lowermost web of the stack and advance it to the next processing stage.

The webs are fed by the assembly including drive chain 326 into a crimp wheel subassembly I having for its function compressing the longitudinal side margins of the webs into beveled tongues dimensioned for reception in the grooves of the chords. The compression is achieved by application of vertically arranged coop-

erating pairs of crimp rolls 380, FIGS. 2b and 7. The crimp rolls serve the supplemental function of picking up the drive of the web members from drive chain 326 and driving them into end-to-end crowded relationship with each other, thereby bringing together the glue-moistened end surfaces of the webs to integrate them into a continuous web.

Next the continuously traveling chords and web are brought together in joist-forming relationship to each other. This is accomplished in the chord and web uniting subassembly J, FIGS. 1b, 2b, and 10.

In this subassembly there are positioned rollers 375 which engage the outer faces of the chords in a relatively upstream position, downstream rollers 416 which engage the inner faces of the chords and serve as fulcrums about which the chords are bent toward in the direction of the webs, longitudinally arranged guide bars 436 which bear against the top and bottom surfaces of the web to prevent it from bowing, horizontal guide rolls 422 which engage the side faces of the chords and guide the chords in the direction of the web, and vertical guide rolls 434 which engage the top surface of the chords and position them vertically.

The net result is to align the tongues of the webs precisely with the glue moistened grooves of the chords, to maintain the chords and webs in their position of precise alignment, and to wedge the tongues into the grooves. This forms a joist assembly which is rendered self-sustaining by the frictional engagement of the tongues of the grooves and in particular by the spring-back force exerted by the fibers of the compressed wood tongues.

The joists thus formed then pass through an adhesive-repellent applicator subassembly K, FIGS. 19, 20, 21 and 22 where a liquid wax or other glue repellent is applied by means of rolls 472, 474 to the edges of the chord components of the joists to prevent them from sticking together as the joists are stacked and nested in subsequent handling. The joists next are cut to length, if necessary, by means of a flying cutoff saw 548, FIG. 19, and conveyed away on a conveyor 550 to such further processing as stacking, oven heating to set the glue, nesting, and bundling for transportation and storage.

Having thus described my invention in preferred embodiments, I claim:

1. In I-beam type truss joist forming apparatus comprising chord feed means arranged to drive longitudinally in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, web member feed means positioned for placing between the chords a plurality of web members arranged end-to-end, web member drive means for driving said web members longitudinally between said chords, and guide means disposed to guide the chords and web members into assembled relation to each other with the side margins of the web members engaged in the grooves of the chords, the improvement wherein said web member feed means comprises:

- a. support means positioned to support a first stack of flatwise-oriented web members between and above the chords,
- b. conveyor means mounted longitudinally between the chords beneath the stack for engaging at timed intervals the lowermost web member of the first stack and conveying it between the chords to said web member drive means, and

c. stack feed means positioned adjacent the support means and operable to feed a second stack of web members onto the top of a partially depleted first stack supported on the stack support means and including skid plate means supporting a second stack to be fed and stack pusher means positioned for pushing said second stack to be fed onto the stack support means, the stack pusher means comprising:

1. reciprocating carriage means provided with at least one pushing arm and
2. drive means connected to the pushing arm for moving it angularly between an advanced angular position wherein it engages and pushes the stack to be fed along the skid plate means on the advancing pass of the carriage, and a retracted angular position wherein it is separated from the stack to be fed on the retracting pass of the carriage.

2. In I-beam type truss joist forming apparatus comprising chord feed means arranged to drive longitudinally in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, web member feed means positioned for placing between the chords a plurality of web members arranged end-to-end, web member drive means for driving said web members longitudinally between said chords, and guide means disposed to guide the chords and web members into assembled relation to each other with the side margins of the web members engaged in the grooves of the chords, the improvement wherein said web member feed means comprises:

- a. first support means positioned to support a first stack of flatwise-oriented web members between and above the chords,
- b. conveyor means mounted longitudinally between the chords beneath the first stack for engaging at timed intervals the lowermost web member of the first stack and conveying it between the chords to said web member drive means,
- c. stack feed means positioned adjacent the first support means for feeding a stack of web members onto the top of a partially depleted first stack supported on the first support means,
- d. second support means positioned adjacent the stack feed means for supporting a plurality of web member stacks aligned in the stack feed direction, and
- e. reciprocating stack-advancing means positioned for advancing the stacks along the second support means and transferring them to the stack feed means, one stack at a time.

3. The apparatus of claim 2 wherein the second support means comprises pallet means.

4. The apparatus of claim 3 including pallet positioning means for positioning the pallet with the stacks in operative alignment with the stack feed means.

5. The apparatus of claim 3 wherein the stack-advancing means comprises a reciprocating carriage and a ram mounted thereon.

6. The apparatus of claim 2 including conveyor means interconnecting the second support means and the stack feed means.

7. The apparatus of claim 6 wherein the conveyor means comprises gravity roller conveyor means.

8. I-beam type truss joist forming apparatus comprising chord feed means arranged to move longitudinally

in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, web member feed means for feeding web members from a supply one at a time between the chords in end-to-end aligned relation to each other, web member drive means and guide means disposed to guide the chords and web members into assembled relation to each other with the side margins of the web members engaged in the grooves of the chords, and a laterally adjustable frame supporting the chord feed means so as to process I-beam type truss joists of variable width, the frame comprising:

- a. a pair of laterally spaced, longitudinally extending frame members supporting the chord feed means,
- b. a plurality of cross frame members interconnecting the longitudinal frame members,
- c. a plurality of V-ways mounted one on each cross frame member
- d. one longitudinal frame member being fixed
- e. roller means mounted on the underside of the other longitudinal frame member and bearing against the associated V-way, and
- f. adjustment means engaging the said other longitudinal frame member for shifting it laterally to the predetermined position of lateral adjustment.

9. The apparatus of claim 8 wherein the adjustment means comprises screw means.

10. The apparatus of claim 8 including indexing means positioned for determining the lateral position of the said other longitudinal frame member.

11. I-beam type truss joist forming apparatus comprising chord feed means arranged to move longitudinally in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, web member feed means for feeding web members from a supply one at a time between the chords in end-to-end aligned relation to each other, web member drive means and guide means disposed to guide the chords and web members into assembled relation to each other with the side margins of the web members engaged in the grooves of the chords, the chord feed means comprising:

- a. pairs of rollers positioned for engagement with opposite surfaces of the chords,
- b. one of the pairs comprising powered rollers for driving the chords in the feed direction,
- c. the other pair being idler rollers applying resilient pressure to the chords,
- d. resilient mounting means mounting said other pair of rollers and comprising a walking beam, journal means journaling the rollers to the walking beam ends and resilient pressure-applying means connected to the central portion of the walking beam.

12. The apparatus of claim 11 including adjustable stop means for positioning the said other pair of rollers and comprising a pair of outwardly extending threaded studs, a fixed limit block, each stud having one end fixed to the walking beam adjacent an end thereof and the other end penetrating the limit block, and lock nut means threaded on the studs and bearing on the limit block.

13. I-beam type truss joist forming apparatus comprising chord feed means arranged to move longitudinally in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, web feed means for feeding webs from a supply one at a time between the chords in end-to-end aligned relation

to each other, web drive means and guide means disposed to guide the chords and webs into assembled relation to each other with the side margins of the webs engaged in the grooves of the chords, the web drive means comprising:

- a. pairs of rotatably mounted upper and lower crimp wheels positioned for engaging the upper and lower surfaces of the webs,
- b. the peripheral surfaces of each pair of wheels being divergently beveled at an angle predetermined to impress tongues in the web side margins,
- c. the wheels of each pair being provided with coplanar integral flanges positioned to contact each other and act as stops, limiting the degree of compression of the web margins, and
- d. drive means connected to the crimp wheels for driving them at the predetermined rotational speed.

14. I-beam type truss joist forming apparatus comprising chord feed means arranged to move longitudinally in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, web feed means for feeding webs from a supply one at a time between the chords in end-to-end aligned relation to each other, web drive means and guide means disposed to guide the chords and webs into assembled relation to each other with the side margins of the webs engaged in the grooves of the chords, and web hold-down means for preventing the bowing of the webs and comprising:

- a. an upper and a lower guide bar assembly, one positioned above and the other below the web in contact therewith in mutually opposed cooperating relation,
- b. each assembly including at least three parallel longitudinally arranged guide bars,
- c. each guide bar comprising a contact shoe bearing against the web and
- d. mounting means mounting each guide bar to a frame member.

15. The apparatus of claim 14 wherein the mounting means for the guide bars of one guide bar assembly comprises resilient mounting means applying resilient pressure to the component guide bars of the assembly.

16. The apparatus of claim 14 including laterally adjustable mounting means for mounting the central guide bar of each guide bar assembly for lateral adjustment.

17. The apparatus of claim 16 wherein the central guide bar mounting means comprises a support arm, a sleeve fixed to the support arm, a horizontal indexing bar receiving the sleeve, and clamp means arranged for clamping the sleeve to the indexing bar at a selected location thereon.

18. I-beam type truss joist forming apparatus comprising chord feed means arranged to move longitudinally in laterally spaced relation a pair of chords having longitudinal grooves in their opposed side faces, automated web feed means for feeding web members one at a time between the chords in end-to-end aligned relation to each other, web member drive means and guide means disposed to guide the chords, web members into assembled relation to each other with the side margins of the web members engaged in the grooves of the chords, and adhesive-repellent applicator means for applying an adhesive repellent to the edges of the chords, said applicator means comprising:

- a. upper and lower rollers positioned for engaging the upper and lower edges of the chords and
- b. roller moistening means associated with each roller and positioned for moistening the surfaces of the rollers with an adhesive repellent liquid.

19. The apparatus of claim 18 including a reservoir containing adhesive repellent liquid and receiving the lower portion of the lower roller for moistening the same, a plurality of liquid-applying nozzles mounted in operative relation to the upper roller for moistening the same, and conduit means including pump means communicating with a source of liquid and positioned for applying liquid to the upper roller.

20. The apparatus of claim 19 including adjustable, fluid operated cylinder mounting means for mounting the nozzles in predetermined positions of vertical adjustment.

21. The apparatus of claim 19 including slide and guide nozzle mounting means for mounting the nozzles in predetermined positions of lateral adjustment.

\* \* \* \* \*

45

50

55

60

65