United States Patent [19]

Eaton et al.

[11] **3,743,113**

[45] **July 3, 1973**

[54] **CARRIAGE DRIVE MEANS FOR LUMBER STACKER**

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[22] Filed: **Jan. 3, 1972**

[21] Appl. No.: **214,726**

[52] **U.S. Cl.** ..... **214/6 DK**, 214/6 M

[51] **Int. Cl.** **B65g 57/10**

[58] **Field of Search** ..... 214/6 M, 6 P, 6 G, 214/6 H, 6 DK

[56] **References Cited**

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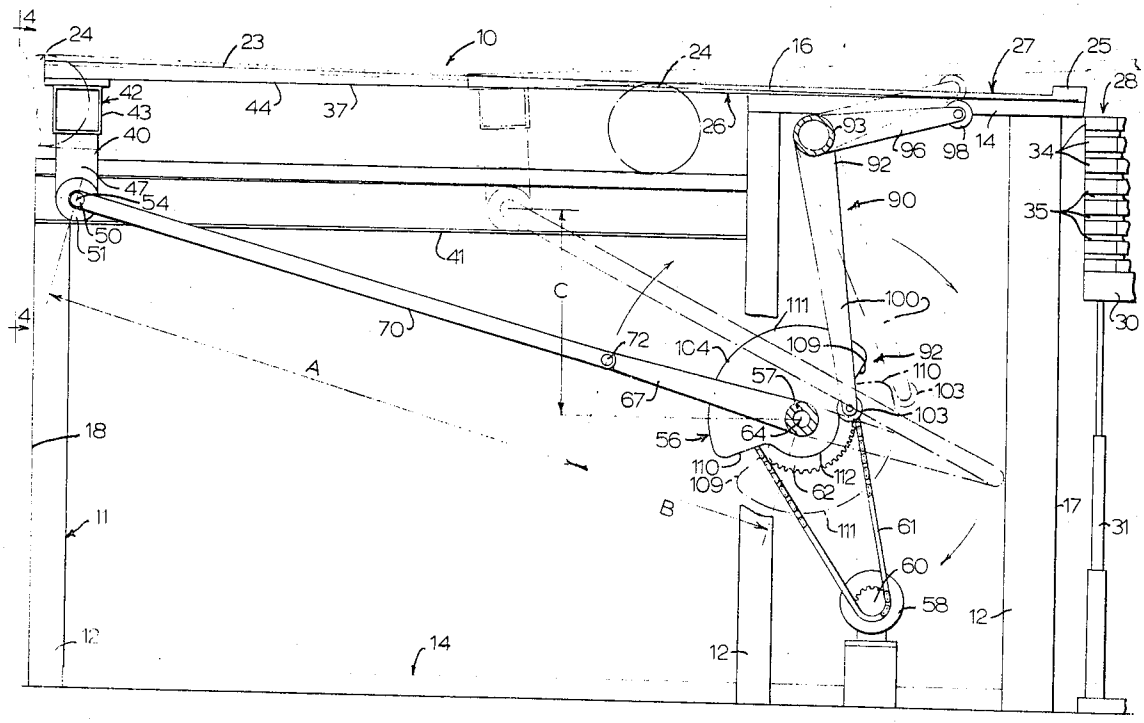
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Attorney—Greek Wells et al.

[57] **ABSTRACT**

A lumber stacking apparatus is described having a reciprocating carriage with a forked arm assembly for picking up a course of boards at a course pickup station and carrying the course to a course stacking station. The carriage is provided with a crank drive mechanism for reciprocating the carriage. The crank drive mechanism has a crank shaft with a cam thereon that operates a bell crank to, (1) raise the forked arm assembly at the course pickup station to pick up a course of boards; (2) maintain the forked arm assembly elevated during movement to the course stacking station, and (3) lower the forked arm assembly at the course stacking station in front of a stripping means.

5 Claims, 5 Drawing Figures



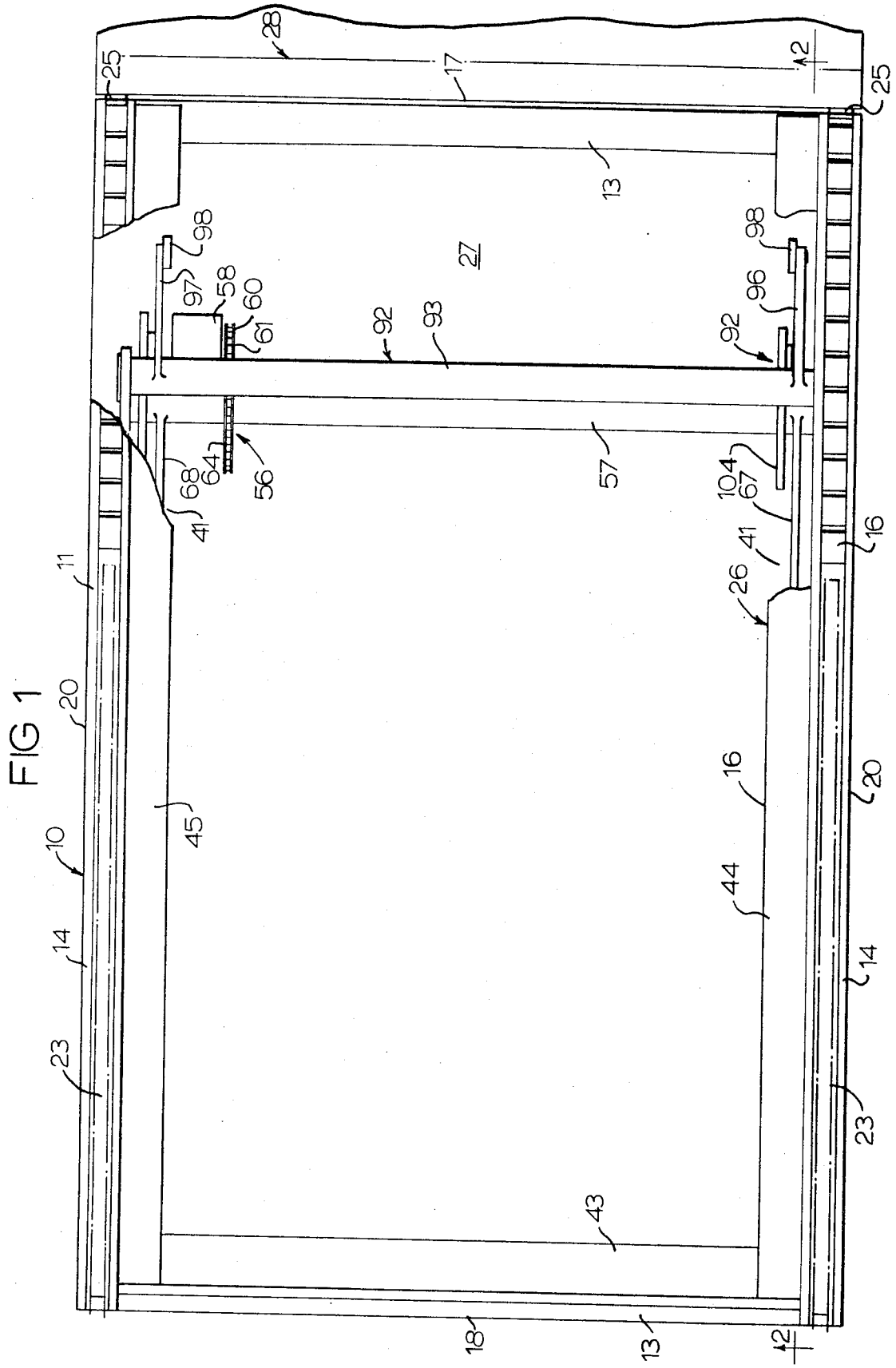

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FIG 1

FIG 2

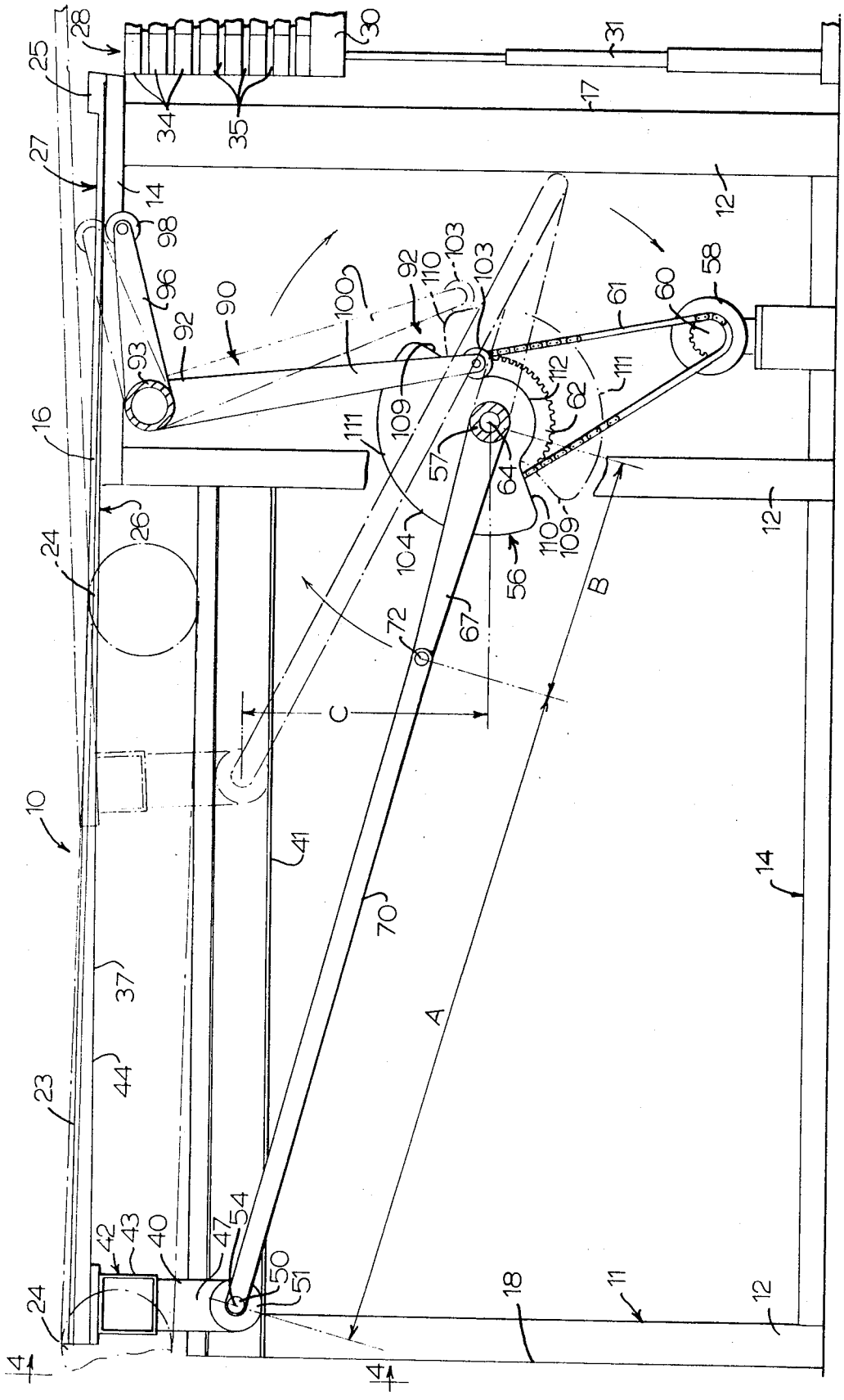
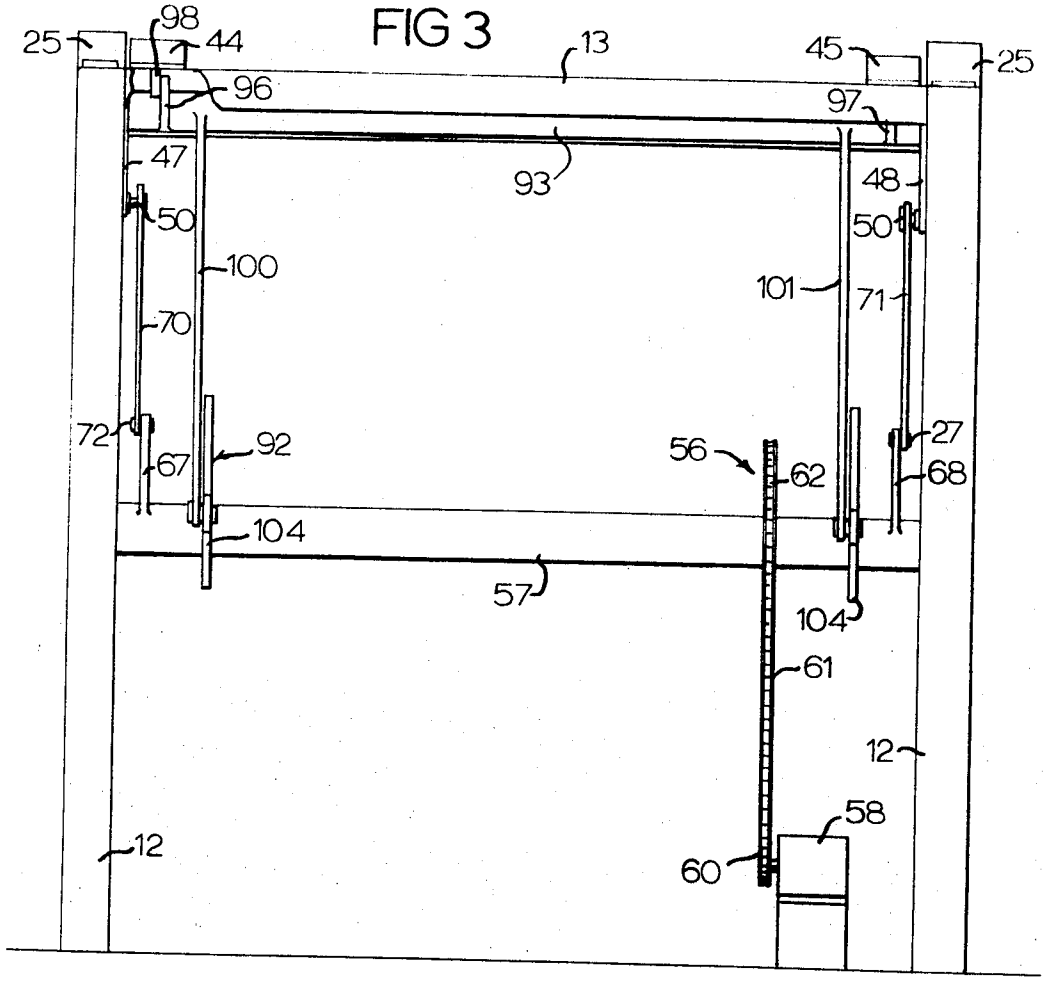

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FIG 3



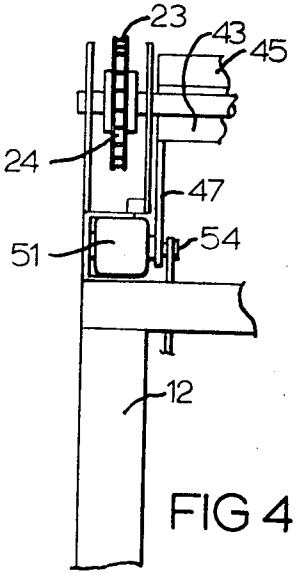


FIG 4

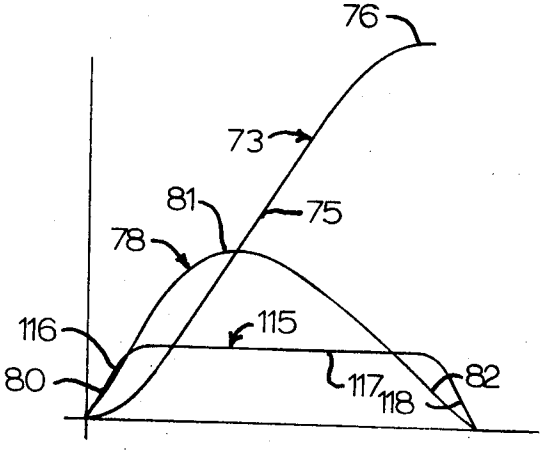


FIG 5

CARRIAGE DRIVE MEANS FOR LUMBER STACKER

BACKGROUND OF THE INVENTION

This invention relates to lumber stackers, and more particularly to the mechanism for picking up a course of boards from a course pickup station and transferring the course of boards to a course stacking station and depositing the course of boards at the course stacking station.

Many lumber stackers utilize a forked arm arrangement that is sequentially moved upward to pick up a course of boards from a course formation station, moved forward to carry the course over a course stacking station, lowered in front of a stripping mechanism and finally retracted past the stripping mechanism to remove the forked arms from underneath the course to place the course on the stack.

Various types of arrangements have been provided to lift the forked arm structures vertically to pick up the course of boards and carry the boards to the stacking station and then lower the boards in front of the stripping means.

One of the principal objects of this invention is to provide a carriage drive means with an associated lifting means that is relatively simple to construct and efficient in operation to provide a low cost lumber stacker that is within the means of small specialty lumber producers.

An additional object of this invention is to provide a crank drive mechanism for reciprocating a lumber stacking carriage in which a unique apparatus is provided to take advantage of the characteristic of the crank drive to raise and lower a forked arm assembly at the beginning and at the end of the reciprocating movement.

These and other objects and advantages of this invention will become apparent upon reading the following detailed description of a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a plan view of a lumber stacking apparatus incorporating the principal features of this invention;

FIG. 2 is a vertical cross-sectional view taken along line 2—2 in FIG. 1 illustrating a drive means for reciprocating a carriage supporting a forked arm assembly and a complementary means for lifting the forked arm assembly at the beginning of the movement of the carriage and lowering the forked arm assembly at the end of the movement of the carriage;

FIG. 3 is a front view of a lumber stacking apparatus illustrated in FIG. 1;

FIG. 4 is a fragmentary vertical view taken along line 4—4 in FIG. 2; and

FIG. 5 is an illustration graph plotting several functions of the movement of the forked arm assembly in relation to a function of the drive means.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Now, referring in detail to the drawings, there is illustrated in FIGS. 1 and 2 a lumber stacking apparatus generally designated with the numeral **10**. The lumber stacking apparatus has a frame **11** comprised of uprights **12** with interconnecting cross member **13** and longitudinal members **14**. The uppermost longitudinal members **14** comprise a generally open platform **16**. The lumber stacking apparatus has a front **17**, rear **18** and sides **20**.

The lumber stacking apparatus includes a feed conveyor **23** that feeds transversely oriented boards from the rear **18** toward the front **17** on the platform **16**. The feed conveyor **23** includes feed chains mounted on sprockets **24**. Stops **25** are mounted on the frame **11** adjacent the front **17** projecting into the path of the boards to limit the forward movement of the boards on the platform **16**.

The top of the platform **16** may be considered a course formation station to enable individual boards to build up behind the stops **25**, until a full course is formed. Alternately, the course may be formed elsewhere and moved as a course to the stacking apparatus. The area on the platform **16** immediately behind the stops **25** may be considered as a course pickup station **27**. The lumber stacking apparatus has a course support means **26** for, (1) picking up a formed course at the course pickup station **27** and elevating the course above the stops **25**; (2) moving the course over the stops **25** to the front **17**; (3) lowering the course below the top of the stops **25**, and (4) stripping the course against a stripping means to deposit the course on a platform **30** at a course stacking station **28**. This process is continued to deposit each course upon a succeeding course to form a stack of a plurality of layers **34**. The platform **30** is indexed downward by a hoist or indexing means **31**. The specific type of hoist or indexing means is not particularly important to this invention and various types of units may be readily utilized. Frequently, stickers **35** are positioned transversely between the layers to facilitate the drying of the individual boards with a minimum of warping.

Course support means **26** has a forked arm assembly **37** that is mounted on a carriage **40**. The carriage **40** is mounted for longitudinal reciprocating movement in longitudinal tracks **41** to carry the forked arm assembly **37** from the course pickup station **27** to the course stacking station **28**. The carriage **40** includes a carriage frame **42** having a cross member **43**. Forked arms **44** and **45** are fixed to the cross member **43** and extend forward forming the forked arm assembly. Side brackets **47** and **48** are fixed to cross member **23** and extend downward adjacent sides **20** as shown in FIGS. **2** and **3**. The brackets **47** and **48** support stud shafts **50** that extend outward to both sides of the brackets. Rollers **51** (FIG. **4**) are mounted on the stud shafts **50** for riding in the tracks **41** to enable the carriage to reciprocate back and forth to move the fork arms between the course pickup station and the course stacking station. The stud shafts **50** define a pivot axis **54** for the forked arm assembly to enable the forked arms **44** and **45** to be pivoted up and down about the moving axis **54**.

The lumber stacking apparatus includes a carriage drive means **56**. The carriage drive means **56** has a crank shaft **57** that is rotatably mounted near the front **17**. The crank shaft **57** extends transverse to the longitudinal movement of the carriage. A motor **58** is operatively connected to the crank shaft to rotate the crank shaft in a full circle in a clockwise direction as viewed in FIG. **2**. Preferably, the shaft **57** is rotated at a constant speed. The motor **58** is operatively connected to the crank shaft **57** through a drive train such as a continuous chain **61** extending between a sprocket **60**

mounted on the motor shaft and a sprocket 62 fixed to the crank shaft 57. The crank shaft 57 rotates about a fixed axis 64. Crank arms 67 and 68 are fixed to the crank shaft adjacent the sides 20. Connecting links 70 and 71 interconnect the crank arms 67 and 68 respectively with the stud shafts 50. The crank arms 67, 68 are pivotally connected to connecting links 70, 71 respectively by pivot connections 72.

For purpose of illustration, the length of the arms 67, 68 from the crank shaft axis 64 to the pivot connections 72 is represented by the letter B and the length of the connecting links 70 and 71 between the pivotal connections 72 and the pivot axis 54 is represented by the letter A. It should be noted that in this embodiment the crank shaft axis 64 is vertically displaced slightly from the pivot axis 54 by vertical distance C.

During each revolution of the crank shaft 57 the carriage 40 and forked arm assembly 37 are reciprocated forward moving the forked arm assembly 37 from the course pickup station 27 to the course stacking station 28 and reciprocated rearward returning the forked arm assembly 37 from the course stacking station 28 to the course pickup station 27.

FIG. 5 is an illustration graph depicting the interrelationships between the linear displacement or percentage of stroke movement of the carriage and the velocity of the carriage in relation to the angular displacement of the crank shaft 57. The angular displacement of the shaft about the crank axis is represented by the Greek letter α. The formula for the linear displacement (x) of the carriage in relationship to the angular displacement (α) is of the crank arm, is generally written as:

$$x = B\,(1-\cos\alpha) + (B^2 \sin^2\alpha/2A)$$

The velocity of (v) of the carriage in relation to the angular displacement (α) of the crank arm, assuming a constant angular velocity (w) of the crank arm is generally written as:

$$v = Bw[\sin\alpha + (B \sin 2\alpha]/2A)$$

The acceleration (a) of the carriage in relationship to the angular displacement (α) of the crank arm, assuming a constant angular velocity (w) of the crank arm is generally written as:

$$a = Bw^2\,[\cos\alpha + (B \cos 2\alpha]/A)$$

The formulas [1], [2] and [3] all assume the crank axis 64 and the axis 54 are the same elevation or that C = 0. The offset C shifts the curve somewhat, however the relationships are basically the same. The offset C, with the axis 54 above the crank axis 64, provides for a forward stroke in somewhat greater than 180° movement of the crank and a return stroke (quick return) in somewhat less than 180° movement of the crank. The formulas [2] and [3] assume that the angular velocity (w) is constant.

The linear displacement or percentage of stroke in relationship to the angular displacement of the crank shaft 57 is illustrated by curve 73 in FIG. 5. The angular displacement of the crank is indicated along the abscissa coordinate and the distance traveled (linear displacement) or percentage of stroke is indicated along the ordinate coordinate. The curve 73 has a beginning section 75 in which there is very little movement of the carriage in relation to the angular displacement of the crank. From the beginning section 75, the curve 73 then flows into a rapidly ascending section 75 indicating that there is substantial movement of the carriage in relation to the angular displacement of the crank. The curve 73 then flares out into a rather flat section 76 indicating that there is very little movement of the carriage near the end of the stroke in relationship to the angular displacement of the crank.

A curve identified by the numeral 78 shows the relationship of the velocity of the carriage in relation to the angular displacement of the crank shaft 57. The velocity curve 78 is a modified sine curve that peaks out at less than 90°. The curve 78 has a beginning section 80 that has a greater slope than an ending section 82. The curve 78 ascends rather quickly to a maximum velocity in less than 90° as indicated by the peak section 81. The velocity of the carriage then decreases steadily during the ending section 82 to provide for a gradual and smooth deceleration of the carriage.

The lumber stacking apparatus further includes means 90 (FIG. 2) responsive to and timed with the carriage drive for automatically raising the forked arm assembly 37 at the beginning of the stroke to pick up a course at the course pickup station and maintaining the forked arm assembly 37 elevated to lift the course above the stops 25 as the carriage is moved forward to move the course from the course pickup station to the course stacking station and then automatically lowering the forked arm assembly 37 at the course stacking station in front of the uprights 12. As the carriage is moved in the return stroke the forked arm assembly 37 is maintained in the lowered condition causing the course to be stripped off the forked arm assembly and onto the stack.

The means 90 includes a bell crank arrangement 92 having an elongated transverse shaft 93 that extends between the sides 20 of the lumber stacking apparatus. The shaft 93 rotates about an axis defining a pivotal axis for the bell crank arrangement. Arms 96 and 97 are fixed to the shaft 93 and extend radially therefrom in alignment with the forked arms 44 and 45 respectively. Rollers 98 are mounted on the ends of the arms 96 and 97 for engaging the underside of the forked arms 44 and 45 to support the arms 44 and 45 as the carriage is moved forward and backward. The bell crank arrangement further includes arms 100 and 101 that extend radially from the shaft 93 downward toward the crank shaft 57 and angularly spaced from the arms 96 and 97 about the axis of the shaft 93.

The bell crank arrangement 92 is operated by a cam means 102 that is timed in relation to the movement of the carriage to pivot the bell crank arrangement to raise and lower the rollers 98 to lift and lower the forked arm assembly. The cam means 102 includes a cam follower roller 103 affixed to the end of each arm 100 and 101 for engaging the periphery of identical disc cams 104. The disc cams 104 are affixed on the crank shaft 57 in alignment with the rollers 103 for rotation with the shaft 57. The periphery of the cams 104 have a rapidly increasing radius of curvature surface 109 and a corresponding substantially diametrically opposite, rapidly decreasing radius of curvature surface 110.

A substantially constant radius of curvature surface 111 extends from the termination of the surface 109 to the beginning of the surface 110. Alternatively, the surface 111 may have a slowly decreasing radius of curvature, if the arms 44 and 45 are slowly tapered from the

cross member **42** to their tips. The objective is to maintain the lifted layer above the stops **25** as the layer is moved forward. A diametrically opposite substantially constant radius of curvature surface **112** extends from the termination of the surface **110** to the beginning of the surface **109**. The cam **104** is angularly affixed (timed) on the crank shaft so that the cam follower roller **103** is engaged by surface **109** at the beginning of the stroke to raise the arms **44** and **45** and the cam follower roller **103** is engaged by surface **110** near the end of the stroke to lower the forked arm assembly. After the arms are elevated the cam roller **103** rides on surface **111** to maintain the forked arm assembly **37** elevated during the forward stroke. During the return stroke the roller **103** rides on surface **112** to maintain the forked arm assembly lowered to strip the course therefrom.

The elevational movement of the top surface at the cams **44** and **45** are illustrated in FIG. **5** by the curve **115**. The curve **115** has a rapidly ascending portion **116** at the beginning of the stroke indicating that the forked arm assembly is rapidly elevated at the beginning of the stroke when the cam follower roller **103** is engaged by the surface **109**. Curve portion **117** indicates that the top surfaces of the arms are maintained at the elevated position during the forward movement of the carriage when the roller **103** is engaged by surface **111**. Near the end of the curve **115** is a rapidly descending portion **118** indicating the lowering of the forked arm assembly at the end of the stroke when the roller **103** is engaged by surface **110**.

As shown in the curves, the cam surfaces **109** and **110** are designed and timed in relation to the crank mechanism to raise the forked arm assembly above the stops **25** within at least 20° movement of the crank arms **67** and **68** (α) from a zero position defined by a straight line through the pivotal axis **54**, the pivotal connection **72** and the crank axis **64** in which the crank mechanism is fully extended. Preferably, the surfaces **109** and **110** are designed to raise the forked arm assembly **37** within a 19° movement of the crank from the zero position. Correspondingly, the surface **110** is designed to lower the forked arm assembly within 30° from the 180° position of the crank mechanism (fully retracted) in which the pivot connection **72** is in a straight line with the pivot axis **54** and the crank axis **64**. Preferably, the lowering movement should take place within 27° movement of the crank mechanism about the crank shaft axis **64**.

One of the principal advantages of this invention is the feature that the course is automatically picked up at the course pickup station and lowered at the course stacking station during a period of low velocities and smooth acceleration and deceleration of the carriage due to the very unique and advantageous characteristics of a crank drive. Very few controls are required as the means for raising and lowering the forked arm assembly as directly responsive to the angular movement of the crank.

It should be understood that the above described embodiment is simply illustrative of the principals of this invention and that numerous other embodiments may be readily devised by those skilled in the arm without deviating therefrom. Therefore, only the following claims are intended to define the invention.

What is claimed is:

1. In a lumber stacking apparatus:

means for reciprocating a carriage between a course pickup station and a course stacking station and for vertically moving a course support means on the carriage to pick up a course of boards at the course pickup station and to maintain the course support means elevated as the carriage is moved from the course pickup station to the course stacking station and to lower the course of boards at the course stacking station, comprising:

a rotatable crank shaft;

a crank arm mechanism operatively connected between the carriage and the crank shaft to reciprocate the carriage between the course pickup station and the course stacking station in response to the rotation of the crank shaft;

cam means operatively connected to and driven by the crank shaft in timed relation with the movement of the crank arm mechanism for raising the course support means at the course pickup station, for maintaining the course support means raised during the carriage movement from the course pickup station to the course stacking station and for lowering the course support means at the course stacking station; and

a drive means operatively connected to the crank shaft for rotating the crank shaft to progressively and smoothly accelerate the carriage from the course pickup station and to progressively and smoothly decelerate the carriage at the course stacking station.

2. In the lumber stacking apparatus as defined in claim **1** wherein the drive means rotates the crank shaft approximately full circle at a substantially constant angular velocity during each cycle of operation to move the carriage in a forward stroke from the course pickup station to the course stacking station, and in a return stroke from the course stacking station to the course pickup station in preparation for a succeeding cycle and wherein the cam means includes a cam operatively connected to the crank shaft for rotation about an axis and a cam follower responsive to a contour of the cam and operable for raising and lowering the cam support means and wherein the cam contour has a first surface for engaging the cam follower at the beginning of the forward stroke to raise the course support means and a second surface for engaging the cam follower near the end of the forward stroke to lower the course support means.

3. In the lumber stacking apparatus defined in claim **2** wherein the cam means further includes a bell crank having one end operatively connected to the cam follower and another end operatively connected to means for engaging the course support means during the forward stroke to raise and lower the course support means in response to the engagement of the cam follower with the first and second surfaces respectively.

4. In the lumber stacking apparatus defined in claim **1** further comprising an open platform supporting a course of boards at the corresponding pickup station and wherein the course support means includes a forked arm structure mounted for horizontal movement with the carriage and for vertical movement up through the open platform in which the cam means is responsive to the rotation of the crank shaft engages and raises the forked arm structure at the course pickup station, maintains the forked arm structure raised during the carriage movement from the course

pickup station to the course stacking station and lowers the forked arm structure at the course stacking station.

5. In the lumber stacking apparatus defined in claim 2 wherein the cam is timed in relationship to the rotation of the crank shaft and the first and second surfaces of the cam are designed to engage the cam roller to raise the course support means within a 20° of angular rotation from a zero angular position a fully contracted orientation of the crank mechanism and lower the course support means within a 30° of angular rotation of the crank shaft from a 180° angular position defined by the position of the crank mechanism in a fully extended position.

* * * * *