United States Patent

[11] 3,599,959

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[45] Patented **Aug. 17, 1971**

[54] **ADJUSTABLE CLAMPING FRAME**
7 Claims, 18 Drawing Figs.

[52] **U.S. Cl.** ..... **269/57,** 269/111, 18/DIG. 48, 18/19 P
[51] **Int. Cl.** **B23q 7/02,** B25b 5/02
[50] **Field of Search** ..... 269/31, 111, 113, 114, 118, 119, 120, 121, 55, 56, 57, 104, 110, 304; 18/DIG. 48, 19 P

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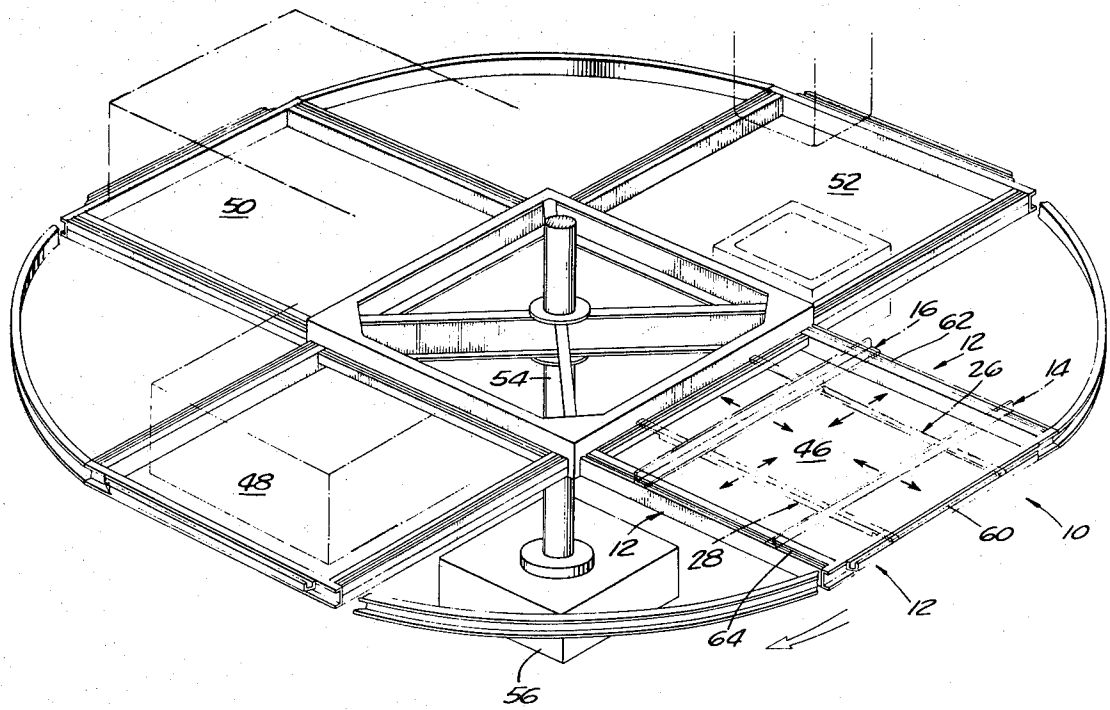
Attorney—Beehler and Arant

ABSTRACT: The illustrated adjustable clamping frame is mounted at one station of a rotary platform thermoforming press. The clamping frame is rectangular and its dimensions are altered by choosing one parallel set of frame sides and giving them uniform properties throughout their entire length up to the maximum capacity of the frame, adjustment being accomplished by changing the length of and spacing between the second set of parallel sides, with the length being precisely determined by a removable gripping bar. A mating jaw for the gripping bar is supported on a carriage from which it is readily removable.



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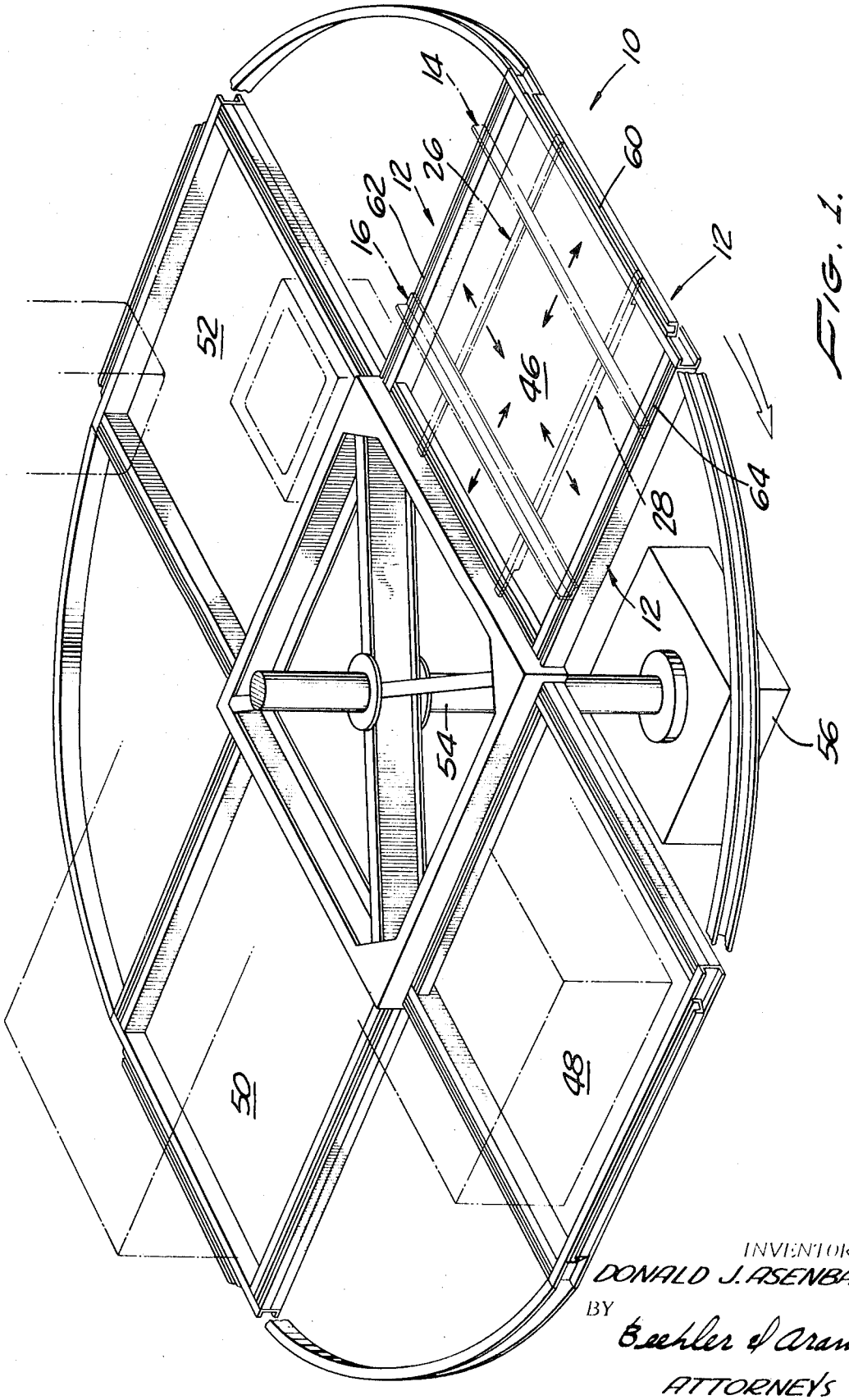

FIG. 1.

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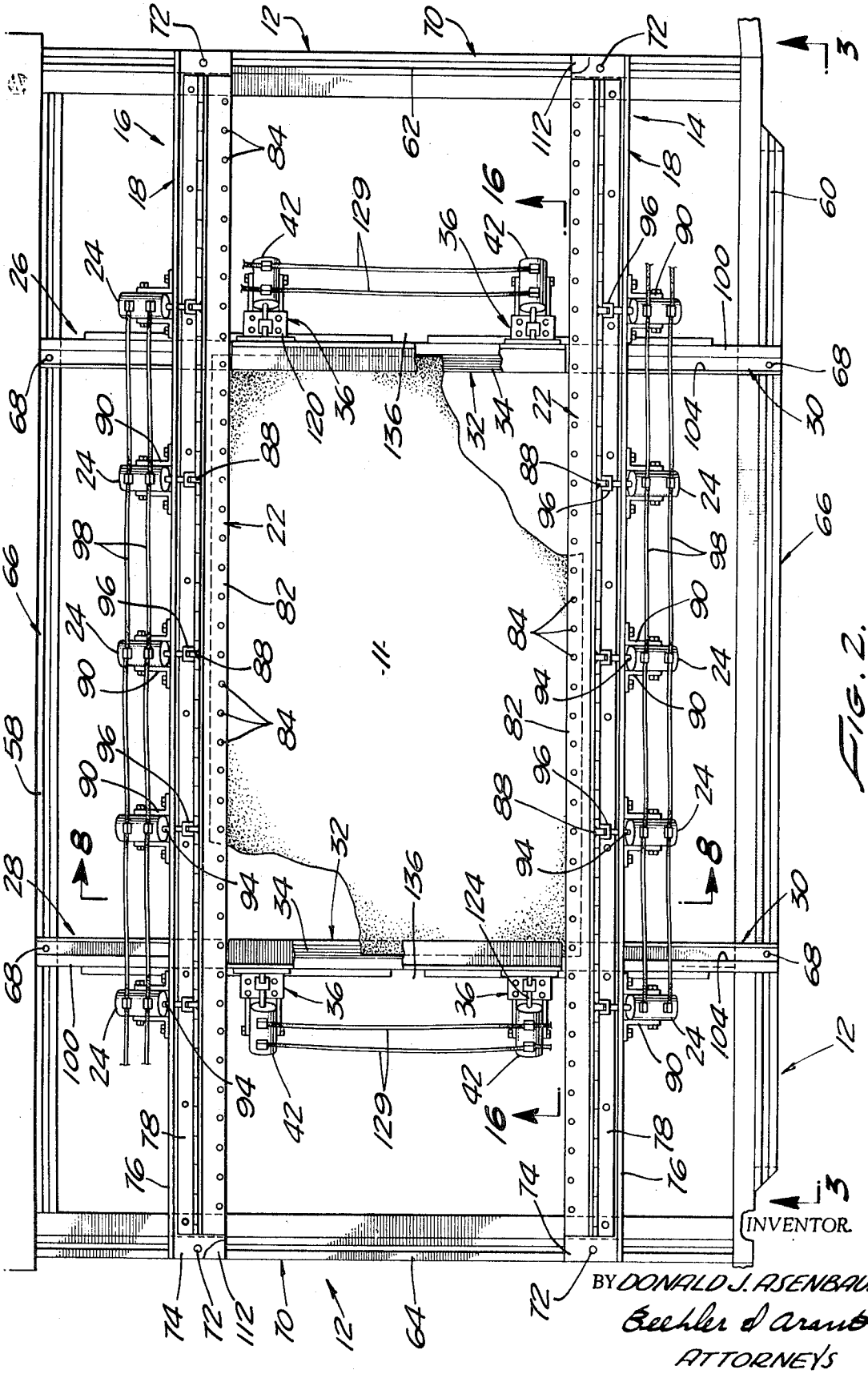

FIG. 2.

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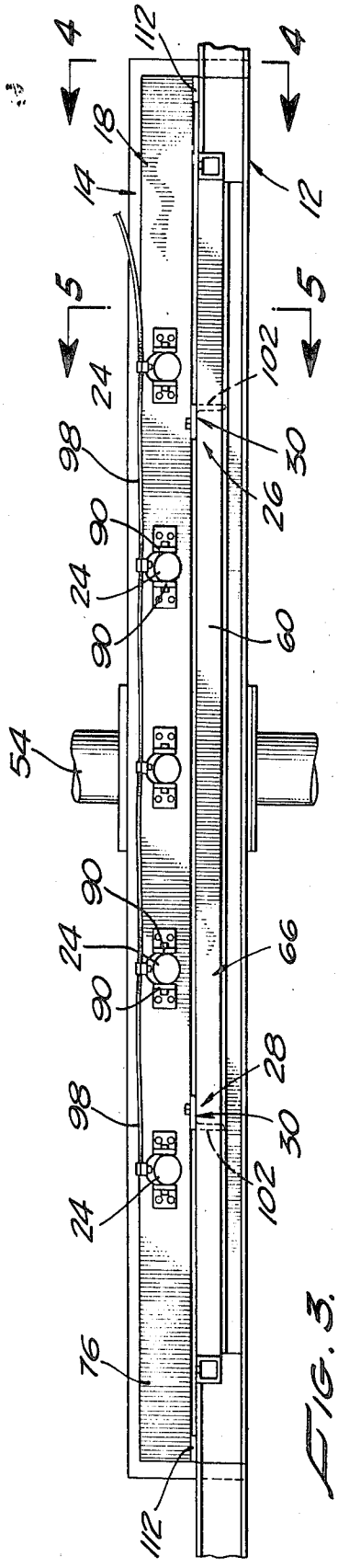

FIG. 3.

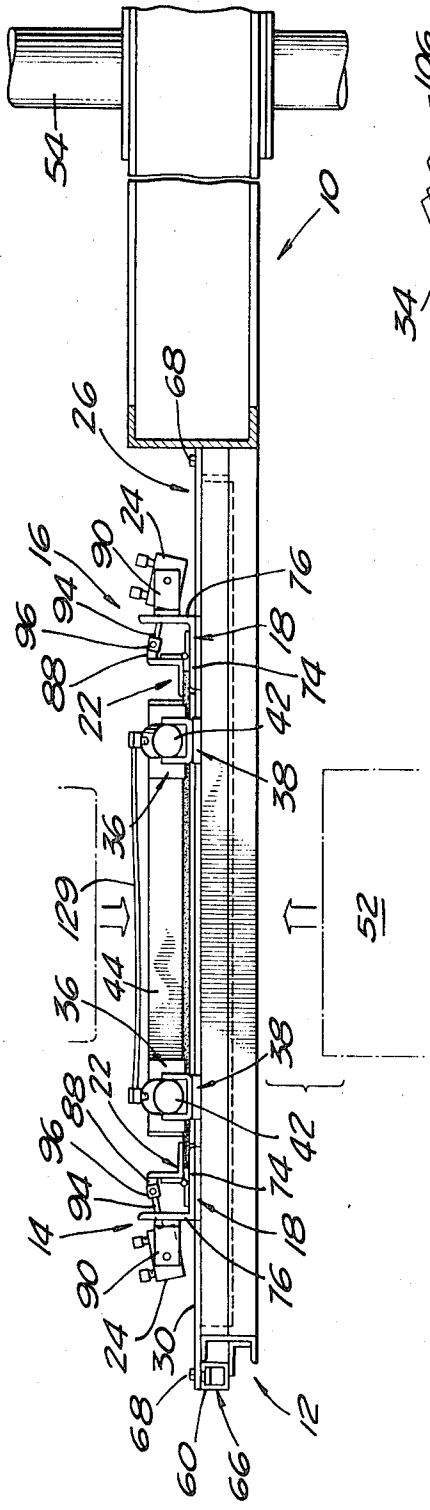

FIG. 4.

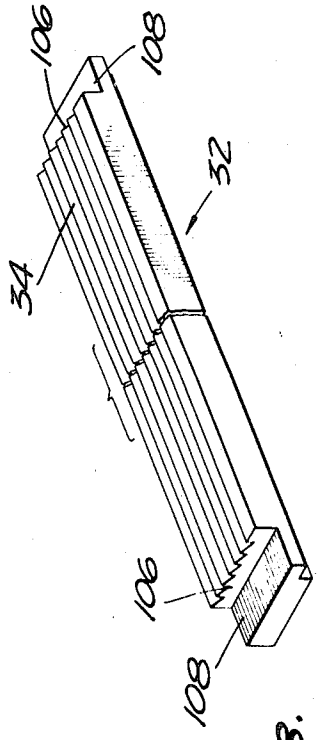

FIG. 18.

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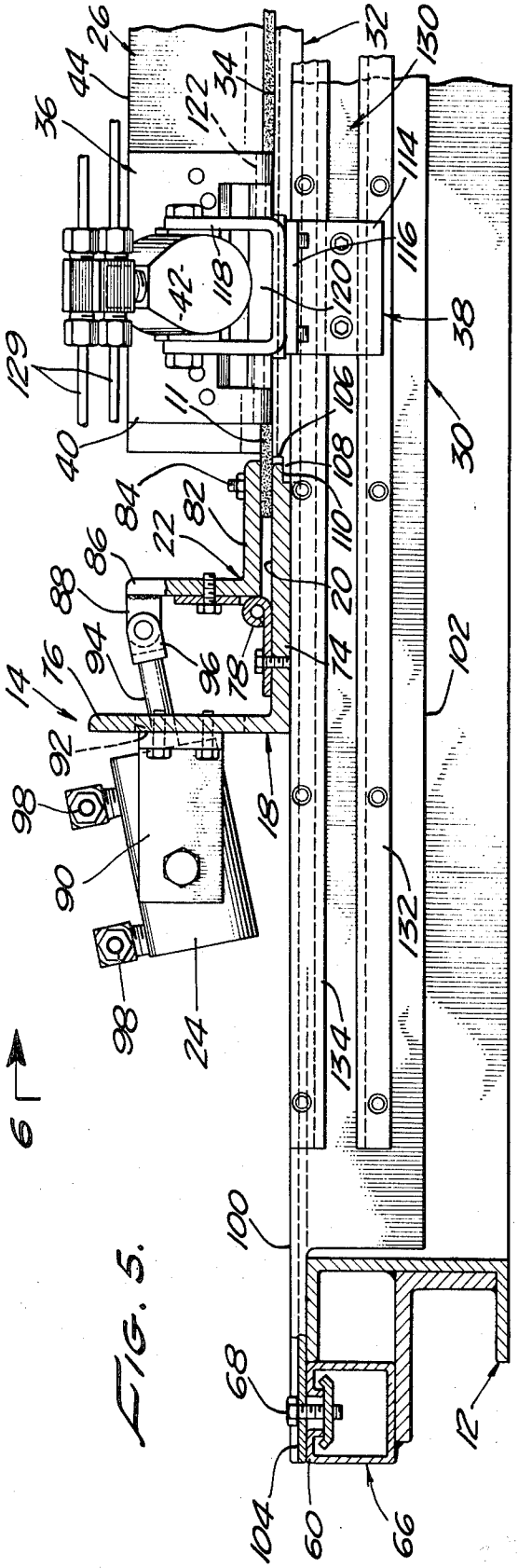

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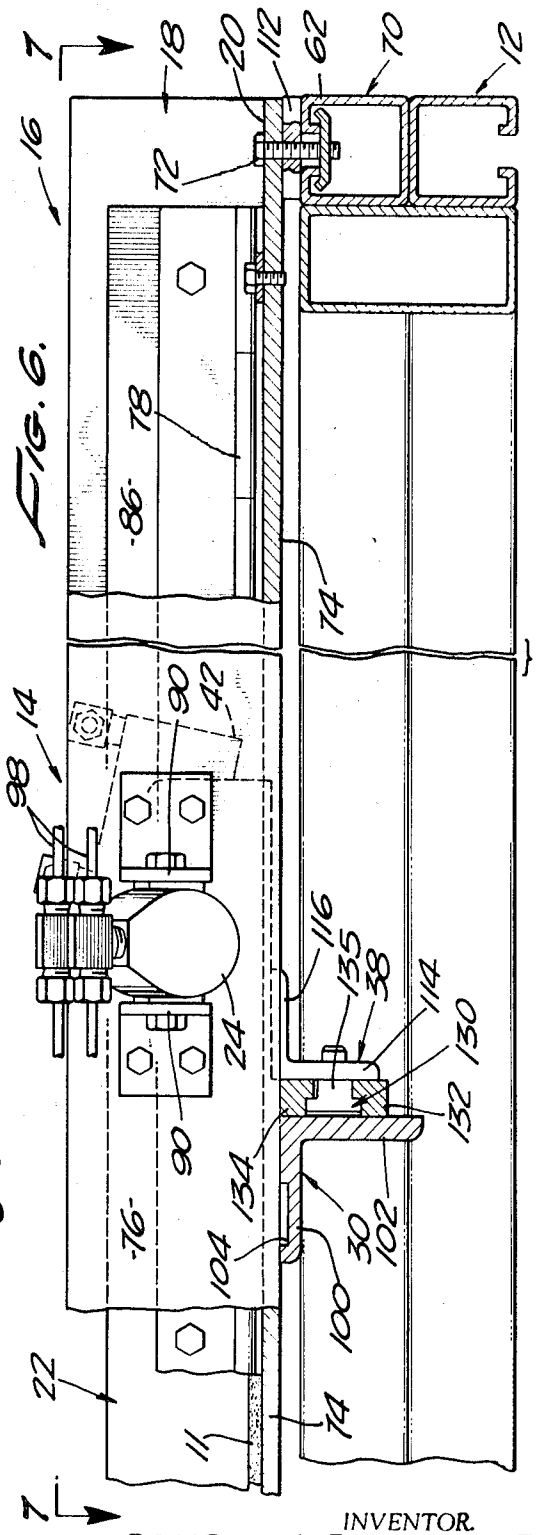

FIG. 6.

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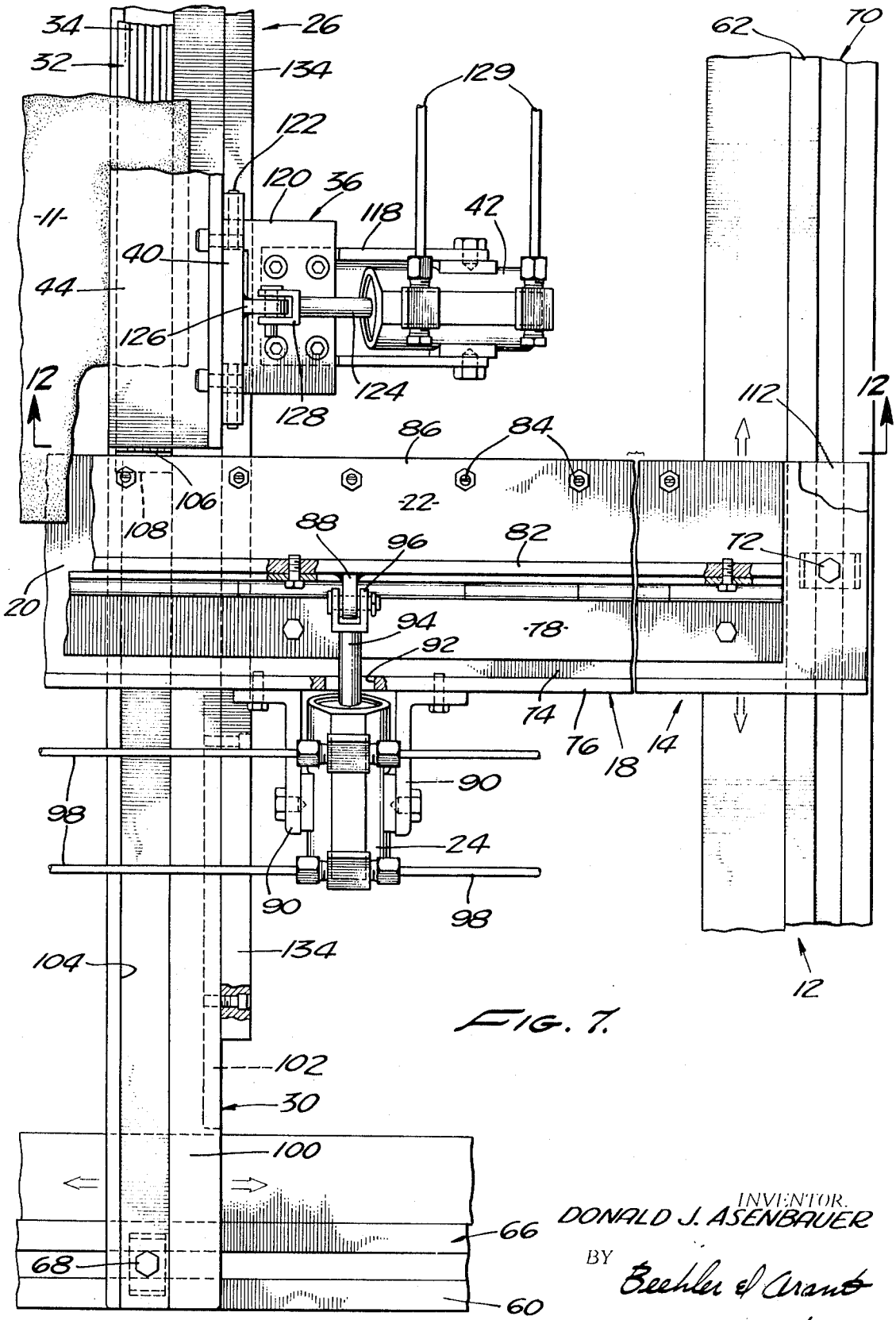

FIG. 7.

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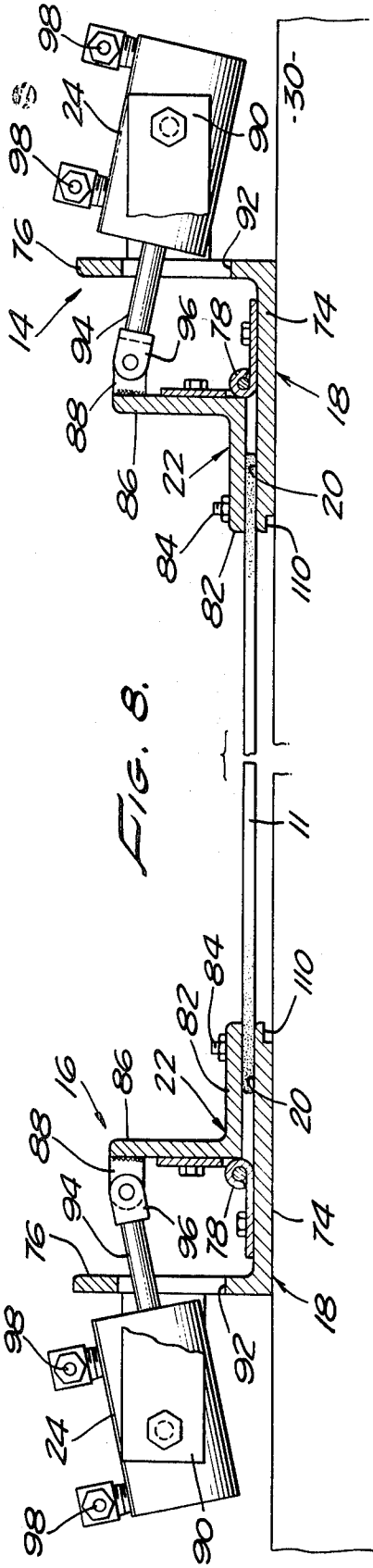

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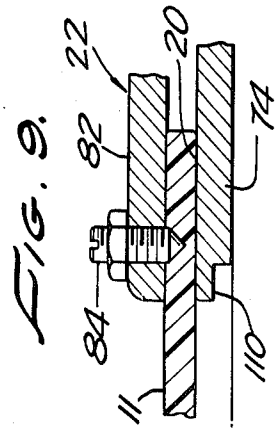

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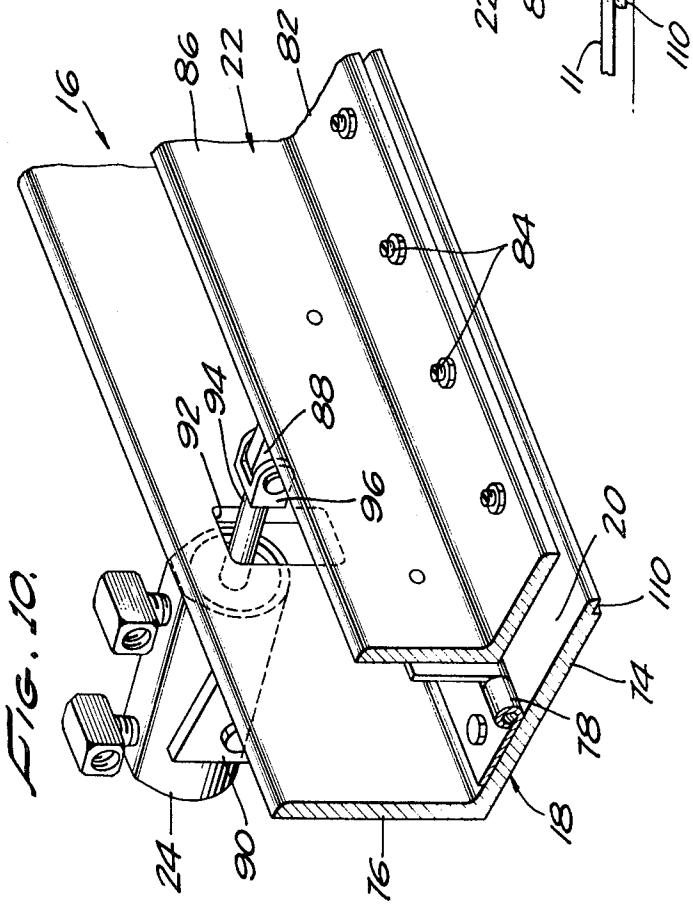

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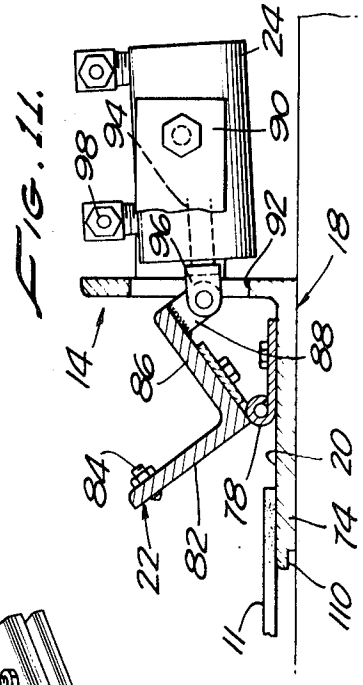

FIG. 11.

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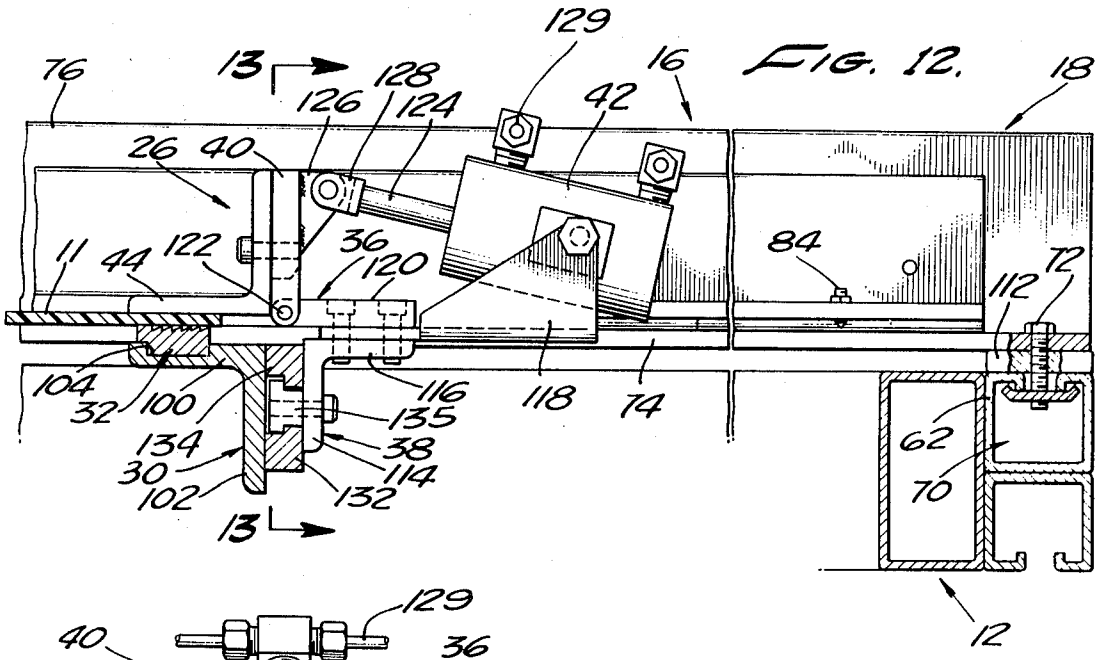

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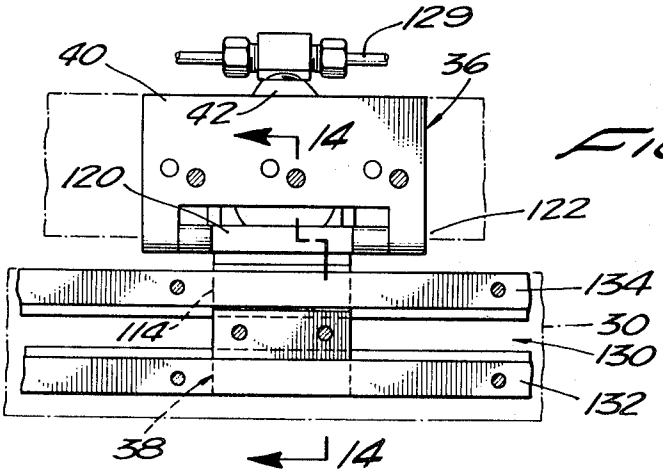
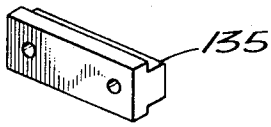


FIG. 13.

FIG. 15.



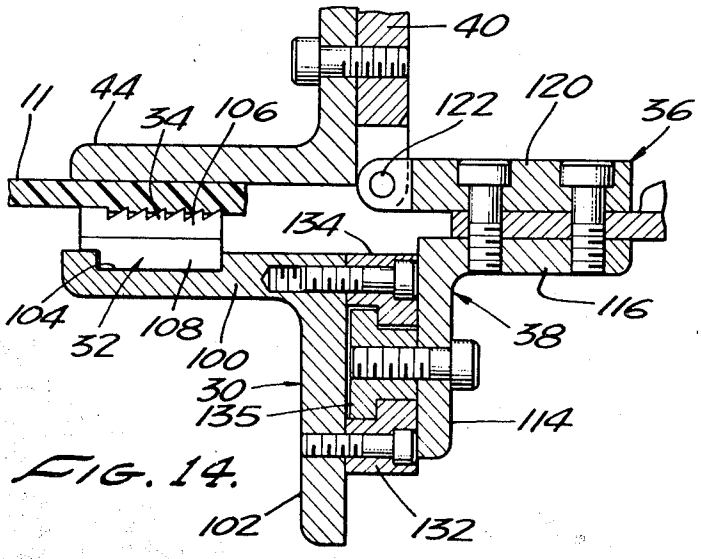


FIG. 14.

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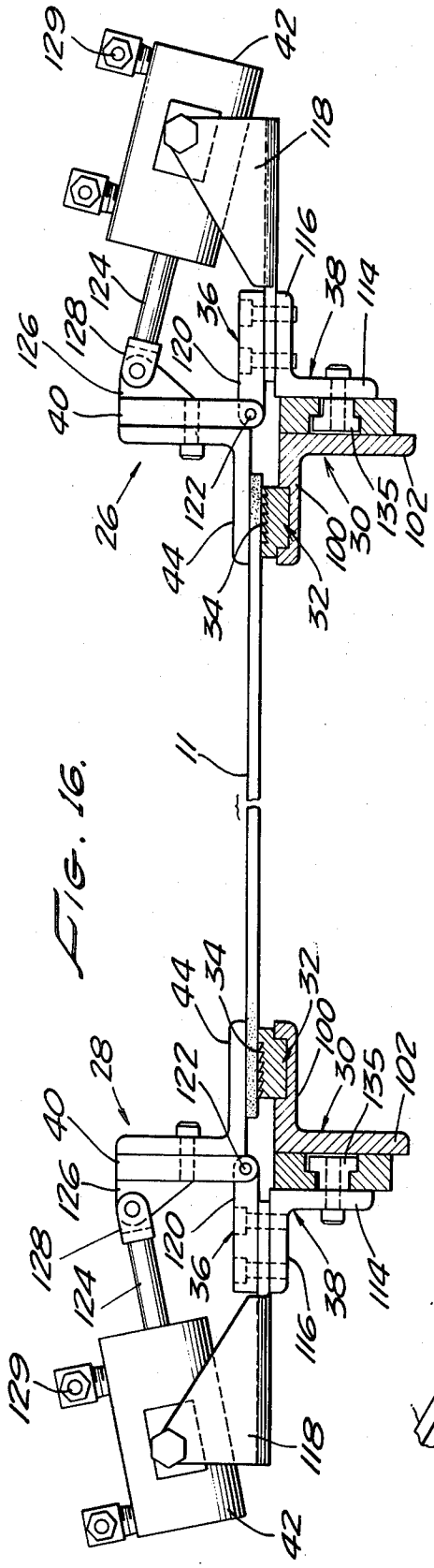

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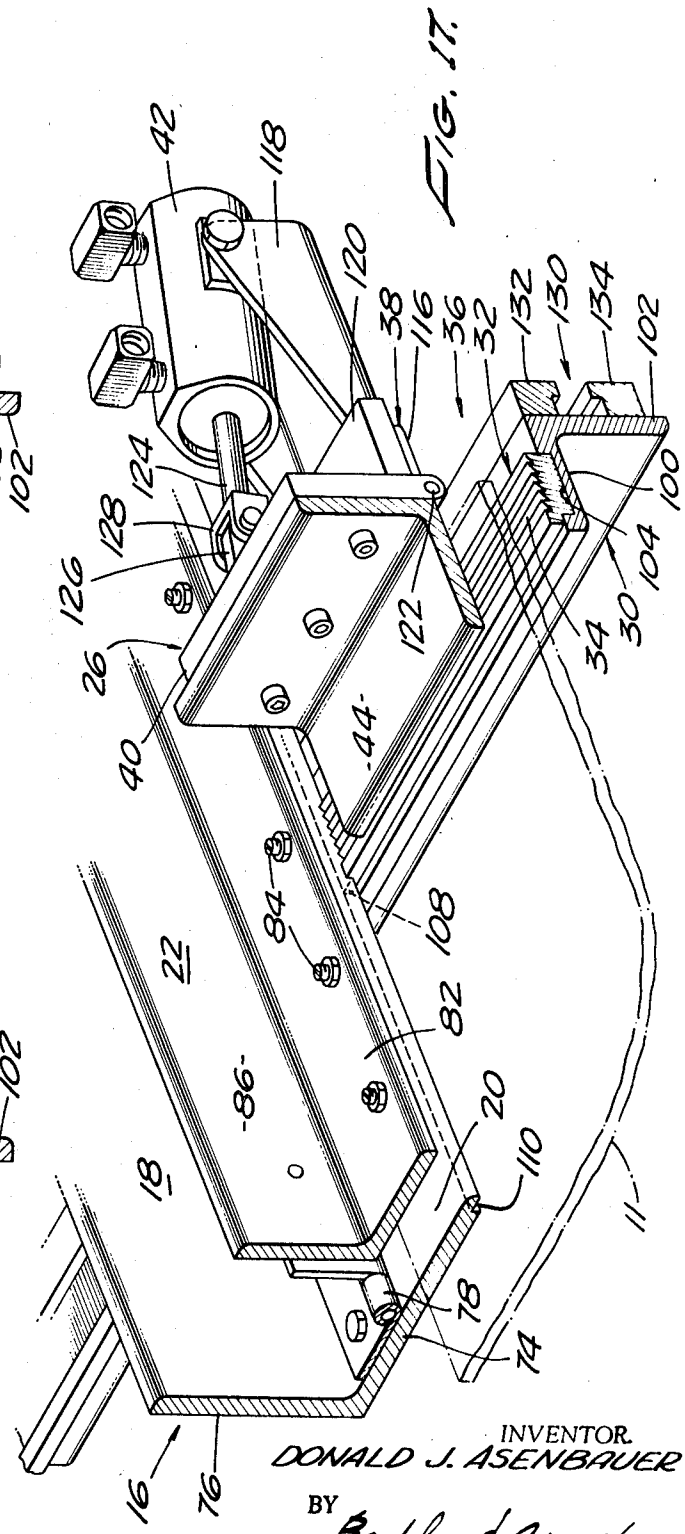

FIG. 17.

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ADJUSTABLE CLAMPING FRAME

The present invention provides an adjustable clamping frame which can be adjusted to grip the outer periphery of a wide variety of generally rectangular shaped work pieces. The adjustment of the clamping frame is accomplished with a minimum of effort.

Previously, considerable difficulty had been encountered in rapidly and satisfactorily adjusting the size of rectangular clamping frames.

These and other difficulties previously encountered have been solved by the present invention. According to the present invention, the frames in one parallel set of side frames of a rectangular clamping frame are chosen, and these frame sides are given a uniform, fixed configuration throughout their entire length up to the maximum capacity of the frame. The second set of parallel clamping frame sides is made adjustable as to length. The adjustment of length is accomplished without altering any complex moving parts. A gripping bar is received in a channel on a supporting frame member in each of the clamping frame sides in the second set. The gripping bar is chosen so as to have the precise length desired for the width between the first set of parallel clamping frame sides. When the gripping bar is in position, it accurately spaces apart the first set of parallel sides. The gripping jaw, which coacts with the gripping bar to hold the edge of a workpiece, is removably mounted on one or more carriages. The carriages are adjustable as to position along the length of the second parallel sides and are substantially shorter than the length of the parallel sides. The mechanism by which movement of the jaws is accomplished is permanently located on the carriage so that the jaw which must be changed to accommodate workpieces of widely different sizes has no moving parts in it. Those moving parts which are expensive and difficult to change are all mounted on the carriages.

The adjustable clamping frames of this invention are e particularly suited for use in rotary platform thermoforming presses where the frame grips a flat rectangular sheet of thermoplastic material at its peripheral edges as the sheet moves sequentially through heating and forming steps.

In the drawings there is illustrated:

FIG. 1 is a schematic perspective view of a rotary platform thermoforming press employing an adjustable clamping frame of this invention;

FIG. 2 is a plan view of an adjustable clamping frame;

FIG. 3 is a sectional, elevational view taken along line 3–3 of FIG. 2;

FIG. 4 is a sectional, elevational view taken along line 4–4 in FIG. 3;

FIG. 5 is a sectional, elevational view taken along line 5–5 in FIG. 3;

FIG. 6 is a sectional and cutaway elevational view taken along line 6–6 in FIG. 5;

FIG. 7 is a sectional and cutaway plan view taken along line 7–7 in FIG. 6;

FIG. 8 is an elevational, sectional view taken along line 8–8 in FIG. 2;

FIG. 9 is an elevational, sectional view of the details of the grip of a longitudinal clamping element on a workpiece;

FIG. 10 is a perspective view of a portion of a longitudinal clamping element;

FIG. 11 is an elevational, sectional view of a longitudinal clamping element in the open configuration;

FIG. 12 is an elevational, sectional view taken along line 12–12 in FIG. 7;

FIG. 13 is an elevational, sectional view taken along line 13–13 in FIG. 12;

FIG. 14 is an elevational, sectional view taken along line 14–14 in FIG. 13;

FIG. 15 is a perspective view of a foot element;

FIG. 16 is a sectional, elevational view taken along line 16–16 in FIG. 2;

FIG. 17 is a perspective view of a corner of the adjustable clamping frame of this invention; and

FIG. 18 is a perspective view of a gripping bar of this invention.

Referring particularly to FIGS. 1, 2, 8, and 16, there is illustrated a clamping frame 10 for a rotary platform thermoforming press. A workpiece 11 is gripped along its periphery in operative position for the accomplishment of work in the rotary platform thermoforming press. Each of the stations of the rotary thermoforming press is provided with a support frame indicated generally at 12. Longitudinal clamping elements indicated generally at 14 and 16 are provided at support frame 12 and extend generally parallel to one another in operative position so as to grasp the periphery of the workpiece 11 extending between their inwardly facing lateral edges. Each of the longitudinal clamping elements 14 and 16 has the same configuration including an elongated rigid base member 18 which is supported at its ends on support frame 12. Elongated rigid base member 18 is movable in lateral directions generally perpendicular to its length. Preferably, the longitudinal clamping elements 14 and 16 extend generally parallel to one another. Elongated rigid base member 18 is provided with a workpiece support face 20. The respective workpiece support faces on longitudinal clamping elements 14 and 16 generally extend in substantially the same plane so that the edges of the workpiece 11 are supported at a common work support level when they rest on the respective work support faces 20. Elongated gripping jaw member 22 is pivotally mounted by means of a continuous hinge on elongated rigid base member 18 for movement between an open released position relative to workpiece support face 20 and a closed workpiece gripping position whereat it coacts with workpiece support face 20 to hold a peripheral edge of workpiece 11. When moving from the gripping to the released position, the jaw members 22 on the respective longitudinal clamping elements move laterally away from one another to expose support faces 20. Fluid pressure responsive cylinders 24 are mounted on elongated rigid base member 18 so that when actuated they serve to move gripping jaw 22 between the open and closed positions. Workpiece support face 20 and elongated gripping jaw member 22 extend along elongated rigid base member 18 for the entire operative length of the longitudinal clamping elements 14 and 16. When the size of the clamping frame is to be adjusted, no changes are required in the configuration of longitudinal clamping elements 14 and 16. The only change required of these clamping elements is that they be moved laterally to adjust the distance between them to a predetermined value.

Transverse clamping elements 26 and 28 are supported at their respective ends on support frame 12. Transverse clamping elements 26 and 28 are movable in lateral directions, which are generally perpendicular to their lengths, so as to adjust the distance between them. Transverse clamping elements 26 and 28 each have the same parts and include elongated rigid beam member 30 which is mounted at its respective ends to support frame 12. A removable gripping bar 32 is supported by elongated rigid beam member 30 so that gripping surface 34 is presented in substantially the same plane occupied by workpiece support faces 20. The coaction between workpiece support faces 20 and gripping surfaces 34 is such that the peripheral edges of workpiece 11 are supported at a common work support level all the way around the clamping frame. A jaw element carriage member 36 is movably mounted on elongated rigid beam member 30 and includes a support member 38, a movable mounting member 40, and a fluid-actuated cylinder 42. An elongated jaw element 44 is removably mounted on jaw element carriage members 36.

Referring particularly to FIG. 1, the clamping frame indicated generally at 10 holds support frames 12 and carries them from one work station to another. A work receiving station is indicated schematically at 46. A first heating station and a second heating station are indicated schematically at 48 and 50, and a forming station is indicated schematically at 52. A molding operation, generally a vacuum forming operation,

is accomplished at station 52. The sheet of thermoplastic material is placed in clamping frame 10 at work receiving station 46. Clamping frame 10 is rotated 90°, and a first heating stage is accomplished at first heating station 48; a rotation of an additional 90° degrees brings the workpiece under the influence of an additional oven at second heating station 50. The softened thermoplastic material is then molded at forming station 52. After it is sufficiently cooled at forming station 52 to stabilize its dimensions, a further rotation of 90° in clamping frame 10 brings the molded article to work receiving station 46 where it is removed and a raw workpiece 11 is inserted in its place.

A clamping frame 10 is carried on shaft 54 which is rotated by means of shaft drive 56.

Referring particularly to FIGS. 2, 5, 6, 7, and 12, there is illustrated a support frame indicated generally at 12 which includes an inner longitudinal track 58, an outer longitudinal track 60, a first transverse track 62, and a second transverse track 64. The respective tracks are defined by longitudinal C sections 66 and transverse C sections 70. Longitudinal tracks 58 and 60 receive and guide track followers 68 which are mounted at the respective ends of transverse clamping elements 26 and 28. Transverse tracks 62 and 64 serve to receive and guide transverse track followers 72 which are mounted at the respective ends of longitudinal clamping elements 14 and 16. The respective track followers 68 and 70 include a bolt which is threadably received in a nut. The outer edges of the nut are upset so as to provide a guide to receive and coact with the lips of the C sections 66 and 70. Positioning of the ends of the respective longitudinal and transverse clamping elements along the respective tracks determines the shape and size of the area between the respective clamping elements.

Referring particularly to FIGS. 2, 3, 4, 5, 7, 8, 9, 10, and 11, there is illustrated longitudinal clamping elements 14 and 16. Longitudinal clamping elements 14 and 16 each have the same component parts including elongated rigid base member 18, elongated gripping jaw member 22, and cylinder 24. The respective ends of elongated rigid base member 18 are supported on transverse tracks 62 and 64. Base member 18 has the general configuration of an angle iron having a horizontal flange 74 and a vertical flange 76. A continuous hinge 78 is mounted on the side of horizontal flange 74 which is adjacent to vertical flange 76. Elongated gripping jaw member 22 is mounted on continuous hinge 78. Elongated gripping jaw member 22 has the general configuration of an angle iron including a horizontal flange 82 and a vertical flange 86. Horizontal flange 82 is adapted to receive and hold headless set screws 84. Headless set screws 84 extend through flange 82 toward support face 20 and serve to securely hold a peripheral edge of workpiece 11. A bearing bracket 88 is mounted on the side of vertical flange 86 which is remote from horizontal flange 82. Cylinder 24 is pivotally mounted in support brackets 90 . Support brackets 90 are mounted on the face of vertical flange 76 which is remote from horizontal flange 74. Port 92 is provided in vertical flange 76 to permit the passage of shaft 94 therethrough. Shaft 94 originates in cylinder 24 and is pivotally attached to bearing bracket 88 by means of clevis fastener 96. Fluid supply lines 98 provide actuating fluid for cylinder 24. Cylinder 24 is a conventional fluid-actuated motor which extends and retracts shaft 94 responsive to the applied force of actuating fluid in fluid supply lines 98. Fluid supply lines 98 may conveniently be of rigid materials since cylinders 24 are mounted at fixed locations along vertical flange 76.

Referring particularly to FIGS. 2, 7, 12, 13, 14, 15, 16, and 17, there is illustrated transverse clamping elements indicated generally at 26 and 28, respectively. Each of the transverse clamping elements 26 and 28 includes the same structural components including elongated rigid beam member 30. The respective ends of elongated rigid beam member 30 are movably supported on longitudinal track 58 and 60. The elongated rigid beam member 30 includes horizontal flange 100 and vertical flange 102 joined together along their respective inner edges at an angle of approximately 90°. A channel 104 is provided in that lateral face of horizontal flange 100 which is most remote from vertical flange 102. Removable gripping bar 32, see particularly FIG. 18, is retained in operative position in channel 104 with its gripping surface 34 extending in substantially the same plane as the workpiece support faces 20 of longitudinal clamping elements 14 and 16. Removable gripping bar 32 rests on and is supported by horizontal flange 100 of transverse clamping elements 26 and 28. The length of removable gripping bar 32 between shoulders 106 is established at a value equal to the desired predetermined distance between longitudinal clamping elements 14 and 16. Tongues 108 extend outward axially from shoulders 106 at a level below shoulders 106 toward the bottom of channel 104. Shoulders 106 and tongues 108 define between them a step at each of the axially opposite ends of removable gripping bar 32. Tongues 108 are received under the respective horizontal flanges 74 of longitudinal clamping elements 14 and 16. Lips 110 are provided on the downward face of the innermost edge of horizontal flanges 74. Lips 110 cooperate with tongues 108 to hold removable gripping bar 32 in channel 104 on elongated rigid beam member 30.

The vertical flanges 76 of longitudinal clamping elements 14 and 16 project upwardly away from the plane in which workpiece 11 is supported, and the vertical flanges 102 of transverse clamping elements 26 and 28 project downwardly away from the work support level at which workpiece 11 is supported. In order to bring the gripping surfaces 34 of transverse clamping elements 26 and 28 and the workpiece support faces 20 of longitudinal clamping elements 14 and 16 into substantially the same plane, while permitting the relative movement of the transverse and longitudinal clamping elements, it is necessary to space the longitudinal clamping elements 14 and 16 from the respective transverse track 62 and 64 by means of spacers 112, see particularly FIGS. 6 and 12. The thickness of removable gripping bar 32 is adjusted to such a value that gripping surface 34 will be in a common work supporting plane with workpiece support faces 20, and the innermost edges of horizontal flanges 74 will be at a level to be in contact with shoulders 106.

Jaw element carriage member 36 is mounted on elongated rigid beam member 30. Each of the jaw element carriage members 36 is composed of the same components, which includes support member 38. Support member 38 has a vertical flange 114 and horizontal flange 116. Support member 38 includes a cylinder support bracket 118 and a plate 120 which is pivotally mounted by means of hinge 122 to movable mounting member 40. Cylinder 42 is pivotally mounted on cylinder support bracket 118. An axially movable shaft 124 extends from cylinder 42 towards bearing racket 126 on movable mounting member 40. Shaft 124 is pivotally connected to bearing bracket 126 by means of clevis fastener 128. Flexible fluid supply lines 129 are connected to cylinder 42 to provide actuating fluid to cylinder 42. A T-shaped foot guideway 130 is defined by guides 132 and 134, respectively. Guides 132 and 134 are mounted on that lateral face of vertical flange 102 which is most remote from horizontal flange 100. A T-shaped foot 135 is mounted to and extends outwardly from that lateral face of vertical flange 114 which is most remote from horizontal flange 116 on support member 38. T-shaped foot 135 is slidably received in T-shaped foot guideway 130. Jaw element carriage member 36 is slidably mounted for movement to different positions along the axial length of elongated rigid beam member 30. Fluid supply lines 129 are flexible so as to accommodate relative movement between several jaw element carriage members 36 mounted along the same elongated rigid beam member 30. The T-shaped foot guideway 130 is discontinuous at, at least one location along the length of elongated rigid beam member 30. A guideway branch 136 is provided to permit the jaw element carriage members to be readily removed from support on elongated rigid beam member 30. The guideway breach 136 is of sufficient length to permit T-shaped foot 135 to pass therethrough. Elongated jaw

element 44 is releasably mounted on the movable s mounting members 40. In general, jaw element 44 is an angle iron of considerably greater length than the movable mounting member 40. Generally , jaw element 44 is carried by two or more carriage members 36. The elongated jaw element 44 is conveniently mounted to the movable mounting members 40 by means of readily releasable fasteners , such as cap screws and the like. The length of elongated jaw element 44 should be less than the length of removable gripping bar 32 between shoulders 106; however, jaw element 44 need not be coextensive with gripping bar 32. The permissible tolerances of the length of jaw element 44 are very broad. Under normal operating conditions when the clamping frame is being employed in a rotary platform thermoforming press, the jaw element 44 may be up to two inches or more shorter than gripping bar 32.

In operation the fluid-actuated motors 24 and 42, respectively, are subjected to the same fluid input simultaneously by coordinated actuating means (not shown) so that elongated jaw elements 44 and elongated gripping jaw members 22 are moved in unison between an open workpiece released position and a closed workpiece gripping position. When the jaw element 44 and jaw member 22 in the opened release position, it is possible to remove an article from position in the area bounded by the inner lateral edges of the respective transverse and longitudinal clamping elements and to replace that article with some raw material, which it is desired to hold securely while work is performed on it. In general, the area bounded by the inner edges of the transverse and longitudinal clamping elements is rectangular in shape with the raw material being in the form of a rectangular sheet having a slightly greater area than that defined by the edges of the clamping elements so that the edges of the workpiece sheet overlap and are supported by gripping surfaces 34 and workpiece support faces 20. As used herein , the term rectangular includes squares and all other four-sided configurations in which the opposed parallel sides are of substantially the same length. If desired, the longitudinal and transverse clamping elements may be made of all different lengths so that their respective inner edges do not extend parallel to one another. When this is done, the area defined between the inner edges of the respective clamping elements is not rectangular.

When it is desired to alter the dimension of the area bounded by the inner edges of the respective clamping elements, this is accomplished by means of the following procedure. The track followers 68 and 72 are released so that the respective clamping elements are free to slide laterally. Two removable gripping bars 32 are chosen having the exact length between their shoulders 106 which it is desired to establish between the respective inner edges of longitudinal clamping elements 14 and 16. The removable gripping bars 32 are placed in the respective channels 104 on transverse clamping elements 26 and 28. The longitudinal clamping elements are moved laterally until their respective inner edges abut shoulders 106 on each of the gripping bars 32. The transverse clamping elements are moved laterally until they are spaced apart the desired width. Track followers 72 and 68 are then tightened to hold the longitudinal and transverse clamping elements securely in the established, desired locations.

Two elongated jaw elements 44 are chosen for releasable attachment to the support members 38 on carriage member 36. The length of jaw elements 44 are chosen so that they are no longer than gripping bars 32. Jaw elements 44 are preferably somewhat shorter than gripping bars 32. Carriage members 36 are mounted on longitudinal clamping elements 14 and 16 by being inserted through guideway breach 136 and slidably received in T-shaped foot guideway 130. The carriage members 36 are adjusted to positions along the transverse clamping elements 26 and 28, such that they will support jaw elements 42 uniformly over gripping bars 32. The flexibility of fluid supply lines 129 permits carriage members 36 to be moved independently of one another. The elongated jaw elements 44 are removably mounted on movable mounting members 40, and the fluid supply lines 129 and 98 are connected to a controlled source of actuating fluid (not shown). The clamping frame is then ready for use.

Throughout this specification and the appended claims, the terms end, side, longitudinal, transverse, inner, outer, upper, lower, horizontal, and vertical are used to indicate positions relative to some other part of the machine rather than relative to the natural horizon. The clamping frame may be rotated to any angle relative to the natural horizon without altering the relationships between its component parts or impairing its effectiveness.

The adjustable clamping frames of this invention are particularly suited for use in thermoforming presses which have more than one operating station, including, for example, shuttle type and rotary type presses. Frames of this invention are also suitable for single station thermoforming presses.

As will be understood by those skilled in the art, what has been described are preferred embodiments in which modifications and changes may be made without departing from the spirit and scope of the accompanying claims.

What I claim is:

1. A rotary platform for use with a thermoforming press ,said platform having a plurality of stations thereon, each of said stations including an adjustable clamping frame comprising:

a support frame;

a pair of longitudinal clamping elements adjustably mounted on said support frame;

a pair of transverse clamping elements adjustably mounted on said support frame, said longitudinal clamping elements intersecting said transverse clamping elements and defining therebetween a rectangular area;

means on each of said longitudinal and transverse clamping elements for supporting and releasably gripping the periphery of a workpiece positioned in said rectangular area, the means on said transverse clamping element including a removable gripping bar having a predetermined length substantially equal to the distance between said longitudinal elements and a jaw element carriage member adapted to pivotally support an elongated jaw element in operative relationship to said gripping bar.

2. A rotary platform of claim 1 wherein the support frame is generally rectangular and includes track members which are adapted to slidably receive track follower elements, said track follower elements being mounted on said longitudinal and transverse clamping elements.

3. A rotary platform of claim 1 wherein each of the longitudinal clamping elements includes an elongated rigid base member, an elongated gripping jaw member mounted on said base member for movement between a released open position and a closed gripping position, said elongated gripping jaw member extending for substantially the full operative length of said longitudinal clamping element, and means mounted on said base member for moving said gripping jaw member between said released and gripping positions.

4. A rotary platform of claim 1 wherein the longitudinal clamping elements include elongated rigid base members extending generally parallel to one another and being slidably mounted at their respective ends to the transverse members of a generally rectangular support frame, and the transverse clamping elements include elongated rigid beam members extending generally parallel to one another and being slidably mounted at their respective ends to the longitudinal members of said support frame, said rigid beam members extending below and generally perpendicularly to said base members.

5. The rotary platform of claim 4 wherein the means for moving the gripping jaw member and the means for moving the mounting member are actuated by coordinated means for simultaneous movement.

6. The rotary platform of claim 1 wherein said longitudinal clamping elements are parallel to one another.

7. The rotary platform of claim 1 wherein said longitudinal and transverse clamping elements enclose therebetween a generally rectangular area.