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ABSTRACT

A method for manufacturing a foam board

A rigid polymeric insulating foam board is manufactured by forming a panel sandwich comprising a lower substrate (1), an upper substrate (2), and foam layer (3) between the substrates (1,2). At or just after the foam gel time and before the foam tack-free time the upper substrate (2) is punctured by a spiked roller (20) to provide a pathway for gas release from the panel. Air streams are applied to substantially remove dirt and grit particles from the foam receiving faces of the substrates (1,2). The foam may be laid down across at least 10% of the width of the substrate (1) by a lay down head (58) in the shape of a fish tail. A stacking system for stacking the foam boards is also described. <Fig.2>

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"A METHOD FOR MANUFACTURING A FOAM BOARD"

Introduction

The invention relates to a method for manufacturing a rigid polymeric insulating foam board of the type comprising a lower substrate, an upper substrate and a foam layer between the substrates.

There are several different methods for manufacturing such boards in a substantially continuous manner. There is however a need to optimise the rate of production with optimised quality, reduced labour and raw material costs and reduced reject rates.

Statements of Invention

According to the invention there is provided a method for manufacturing a rigid polymeric insulating foam board of the type comprising a lower substrate, an upper substrate and a foam layer between the substrates, the method comprising the steps of:-

leading a lower substrate to a lay-down area;

laying liquid foam reactants onto the substrate at the lay-down area;

leading an upper substrate over the foam reactants and the lower substrate;

passing the panel sandwich thus formed through a nipping means to spread the liquid foam reactants;

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allowing the foam to expand between the substrates; and,

at or later than the foam gel time and before the foam tack-free time puncturing the upper substrate to provide a pathway for gas release from the panel.

In one embodiment of the invention the upper substrate is punctured periodically along the length of the panel in timed relation to the rate of movement of the panel. Preferably the apertures are formed across the width of the upper substrate for a period corresponding to a panel length of approximately 2 metres per 12 metres of panel. In a preferred embodiment of the invention the apertures generated on puncturing the upper substrate have a total cross sectional area across the width of the panel of less than 5% of the punctured panel area. Preferably the apertures generated on puncturing the upper substrate have a total cross sectional area across the width of the panel of less than 1% of the total panel area. In one embodiment of the invention the upper substrate is punctured by a spiked roller, and the method includes the steps of moving the spiked roller from an upper disengaged position to a lowered position in which the spikes engage the upper substrate in timed relation to the rate of movement of the panel.

According to one aspect of the invention the method includes the step of applying an air stream to the outer face of at least one of the substrates in advance of passing the panel sandwich through the nipping means to substantially remove grit and dirt particles from the face of the substrate engaged by a nipping means. In this case preferably an air stream is applied to the outer face of the upper substrate in advance of the nipping means.

According to another aspect of the invention the method includes the step of:

applying an air stream to the foam-receiving face of at least one of the substrates in advance of contacting the substrate with the liquid foam reactants to substantially remove grit and dirt particles from the foam receiving face of the substrate. In this case preferably an air stream is applied to the uppermost face of the lower substrate in advance of lay down of liquid foam reactants onto the substrate.

In a further aspect the method includes the steps of:-

cutting the panel thus formed to a desired length; and

stacking the panel lengths thus formed to form a stack;

the panels being stacked by:-

delivering a leading panel to a stop means at a stacking bed,

raising the leading panel above the stacking bed and retaining the leading panel above the stacking bed while delivering a following panel to the stacking bed.

lowering the leading panel onto the following panel;

raising the leading and following panels above the stacking bed and retaining the panels above the stacking bed while delivering a further panel to the stacking bed; and

on completion of the stack, lowering the stack of panels onto the stacking bed and releasing the stop means to allow delivery of the stack of panels from the stacking bed.

Preferably the panels are raised above the stacking bed by support legs and the method includes the step of moving the support legs from a recessed position below the stacking to a raised panel-supporting position above the bed.

In a preferred embodiment of the invention the panels are retained in a raised position above the bed by side retaining arms and the method includes the step of pivoting the side retaining arms inwardly from a released position to a panel engaged position.

In a further aspect of the invention the liquid foam reactants are laid down on the lower substrate through a fixed foam lay down head having an elongated foam outlet slot through which liquid foam reactants are laid down across a portion of the width of the lower substrate. Most preferably liquid foam reactants are laid down across at least 10% of the width of the lower substrate.

Any or all of the various aspects of the invention may be combined in any desired combination.

The invention also provides a rigid polymeric insulating foam board whenever manufactured by the method of the invention.

Brief Description of the Drawings

Fig. 1 is a diagrammatic side, partially cross sectional view illustrating various steps in the method for manufacturing a foam board;

Fig. 2 is a perspective view of a puncturing apparatus used in the method of the invention;

Fig. 3 and 4 are side, partially cross sectional views of the puncturing apparatus of Fig. 2 in different positions;

Fig. 5 is a perspective view of an air stream applying means used in the method of the invention;

Fig. 6 is a perspective view of another air stream applying means used in the method of the invention;

Fig. 7 is a perspective view of a liquid foam reactants lay down apparatus used in the method of the invention;

Fig. 8 is a plan view of the foam lay down apparatus of Fig. 7;

Fig. 9 is a perspective view of a board stacking apparatus used in the method of the invention;

Fig. 10 is a perspective view of a detail of the apparatus of Fig. 9; and

Fig. 11(a) to 11(f) are diagrams illustrating the operation of the stacking apparatus of Figs. 9 and 10.

Detailed Description

Referring to the drawings there is illustrated a method for manufacturing rigid polymeric insulating foam boards of the type comprising a lower substrate 1, an upper substrate 2 and a foam layer 3 between the substrates 1, 2.

Referring particularly to Fig. 1, in general, in the method of the invention the lower substrate 1 is led from a supply reel to a lay-down area 5 at which a stream of liquid foam reactants are laid down onto the lower substrate 1. The upper substrate 2 is led from a supply reel over the foam reactants. The panel sandwich thus formed is then passed under a nipping means 10 which spreads the liquid foam reactants evenly across the width of the substrates 1,2. The foam starts to

expand, the rate of expansion being controlled by lower heated beds 12 and upper weighted plates 13 before the panel sandwich is delivered into an oven 15.

Just before the panel sandwich enters the oven 15 which corresponds with at or just after the foam gel time and before the foam tack-free time the upper substrate 2 is punctured by a spiked roller 20 to provide a pathway for gas release from the panel. Referring particularly to Figs. 2 to 4 the roller 20 is rotatably mounted in bearings 21 carried on support arms 23, which are pivotally mounted on pivot pins 22. The pivot pins 22 are carried by lugs 24 extending from a main support bar 25 of a support framework 26. The support arm 23 includes an upwardly projecting cranked extension 27, the free ends of which are mounted to rods 29 of respective rams 30. The rams 30 are operated to move the support arms 23 and hence the roller 20 from the raised in-operative position illustrated in Fig. 3 into a lowered upper substrate puncturing position illustrated in Fig. 4 in which the spikes of the roller 20 form apertures 35 in the upper substrate 2. The depth to which the spikes puncture the foam is controlled by set screws 37.

The apertures 35 formed on puncturing the upper substrate 2 provide a pathway for gas release to ensure that uniform foaming is achieved over the length and width of the panel and especially to ensure uniform adhesion between the substrate 2 and the foam core. For maximum adhesion the apertures are formed at or later than the foam gel time and before the foam tack-free time. The upper substrate 2 is punctured periodically along the length of the panel in timed relation to the rate of movement of the panel, preferably the apertures 35 being formed across the width of the upper substrate 2 for a period corresponding to a panel length of approximately 2 metres per 12 metres of panel. The apertures, 35 generated on puncturing have a total cross sectional area across the width of the panel of less that 1% of the total panel area (apertured and not apertured area). In the punctured area of the panel the apertures 35 have a total cross sectional area across the width of the panel of less than 5% of the punctured panel area.

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Referring particularly to Figs. 1, 5 and 6 an air stream is applied by a first air blowing tube 50 to the foam receiving face 51 of at least one of the substrates, and in this case the lower substrate 1 in advance of contacting the substrate 1 with the liquid foam reactants to substantially remove grit and dirt particles from the foam receiving face 51 of the substrate 1. The air steam is delivered to the tube 50 through an air feed line 52 and exits through an elongate slot 53. The tube 50 is arranged at an angle with respect to the moving substrate 1 for maximum cleaning efficiency.

A second air blowing tube 55, similar to the first tube 50 and like parts being assigned the same reference numerals, is arranged to apply an air stream to the inner face 56 of at least one of the substrates, in this case the upper substrate 2, in advance of passing the panel sandwich through the nipping means 10. In this way dirt and grit particles are substantially removed from the substrate engaged by the nipping means 10.

To optimise the spread of liquid foam reactants across the substrate 1 the liquid foam reactants may be laid down through a lay down head 58 illustrated in Figs. 7 to 8. The lay down head 58 is in the shape of the fish tail and has an elongate outlet opening 59 from which the foam reactants are laid down simultaneously across a significant width, which is preferably at least 10% of the width of the substrate to maximise the even spread of the foam reactants.

After heating in the oven 15 to cure the foam, the continuous panel is trimmed and automatically cut to a desired length of insulated board.

Referring particularly to Figs. 9 to 11 the boards are stacked by first delivering a leading board 60 to a stop means provided by drop arms 61 at a stacking bed 62. The leading panel 60 is raised above the stacking bed 62 by support legs 63 which are ram operated for movement from a recessed position below the stacking bed 62 as illustrated in Figs. 9, 11(a), 11(d) and 11(e) to a raised panel-supporting

position above the bed 62 as illustrated in Figs 10, 11(b) and 11(c). To retain the leading panel 60 in the raised position illustrated in Fig. 11(b) side retaining arms 65 are pivoted inwardly from a release position illustrated in Figs. 11(a) and 11(b) to a panel engaged position illustrated in Fig 11(c). A following panel 70 is then delivered to the stacking bed 62 into the position illustrated in Fig. 11(d) in which the following panel 70 is located directly below the leading panel 60.

The leading panel 60 is then released by the arm 65 so that it rests on the following panel 70 at the stacking bed 62 and the support legs 63 are raised to lift both panels 60, 70 above the stacking bed 62. In this position the lowermost panel 70 is then retained by the retaining arms 65 and the support legs 63 are retracted so that the stacking bed 62 is in a configuration to receive a further panel. A stack of panels is built up in this way and, on completion of the stack, the drop arms 61 are lifted as illustrated in Fig. 11(f) to allow delivery of the stack of panels from the stacking bed 62.

The invention provides a highly efficient method for manufacturing and handling rigid polymeric insulating foam boards to a high level of quality with optimised rates of production and minimum reject rates.

The invention is not limited to the embodiments hereinbefore described which may be varied in construction and detail.

CLAIMS

1. A method for manufacturing a rigid polymeric insulating foam board of the type comprising a lower substrate, an upper substrate and a foam layer between the substrates, the method comprising the steps of:-

leading a lower substrate to a lay-down area;

laying liquid foam reactants onto the substrate at the lay-down area;

leading an upper substrate over the foam reactants and the lower substrate;

passing the panel sandwich thus formed through a nipping means to spread the liquid foam reactants;

allowing the foam to expand between the substrates;

wherein the liquid foam reactants are laid down on the lower substrate through a fixed foam lay down head having an elongated outlet slot through which liquid foam reactants are laid down across a portion of the width of the lower substrate.

2. A method as claimed in claim 1 wherein liquid foam reactants are laid down across at least 10% of the width of the lower substrate.

3. A method of manufacturing a rigid polymeric insulating foam board substantially as hereinbefore described with reference to the accompanying drawings.

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4. A rigid polymeric insulating foam board whenever manufactured by a method as claimed in any preceding claim.

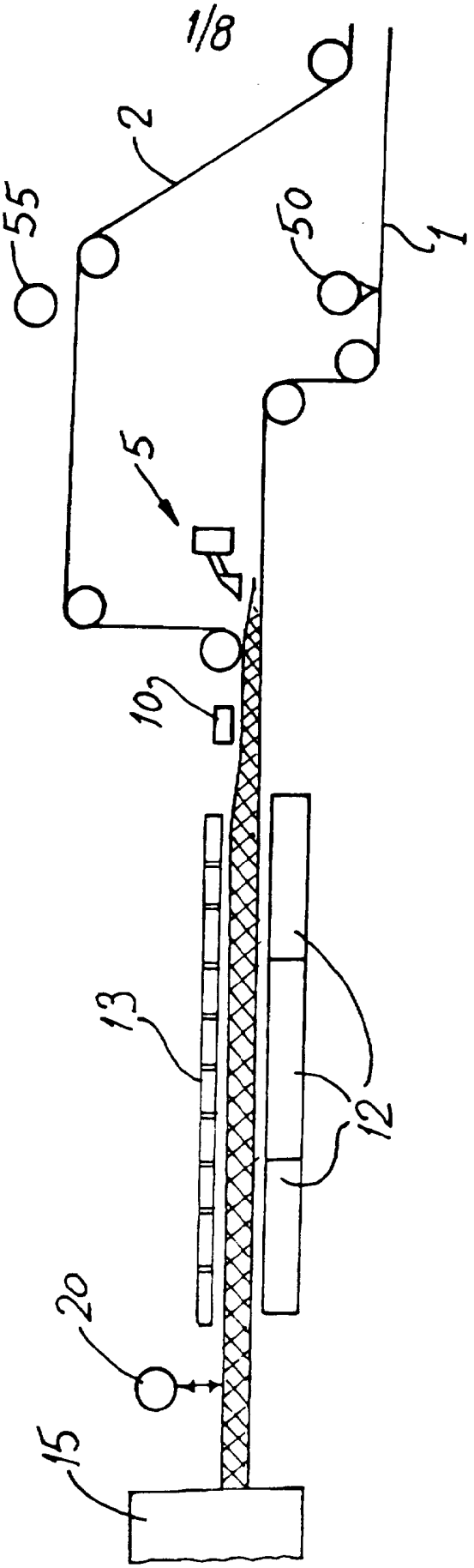

Fig.1

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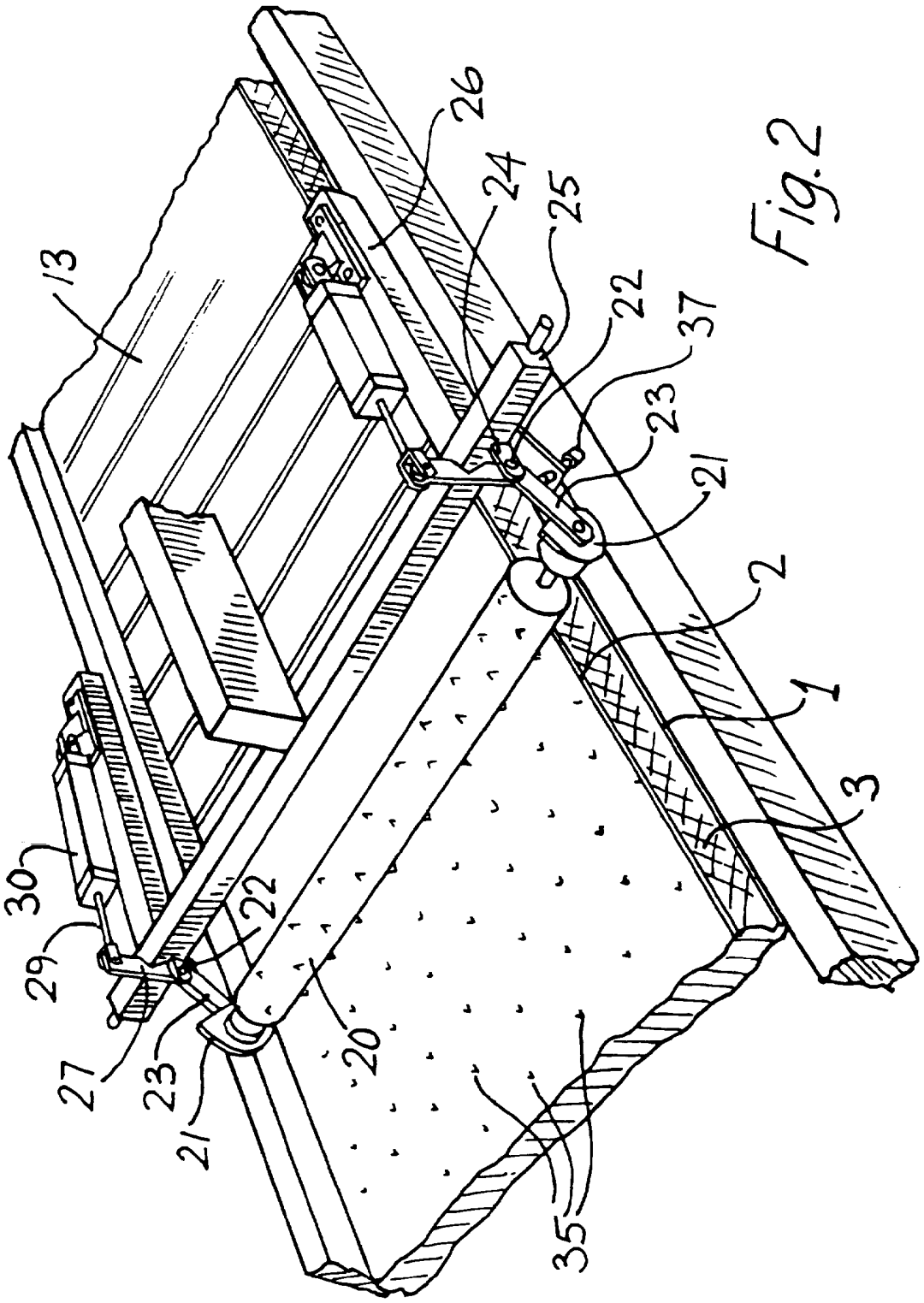

Fig.2

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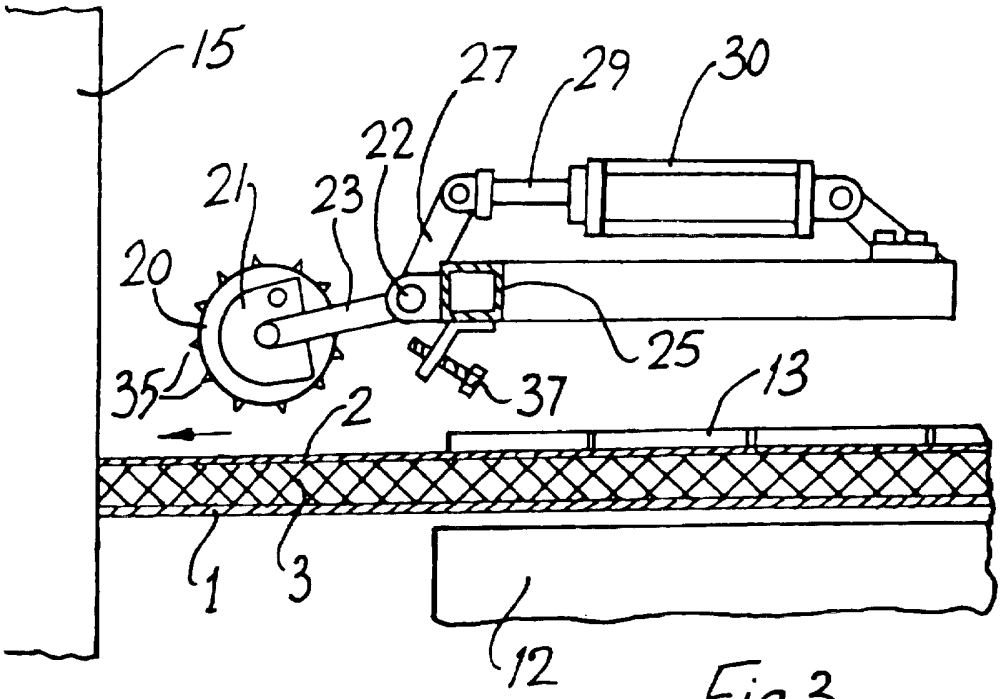

Fig.3

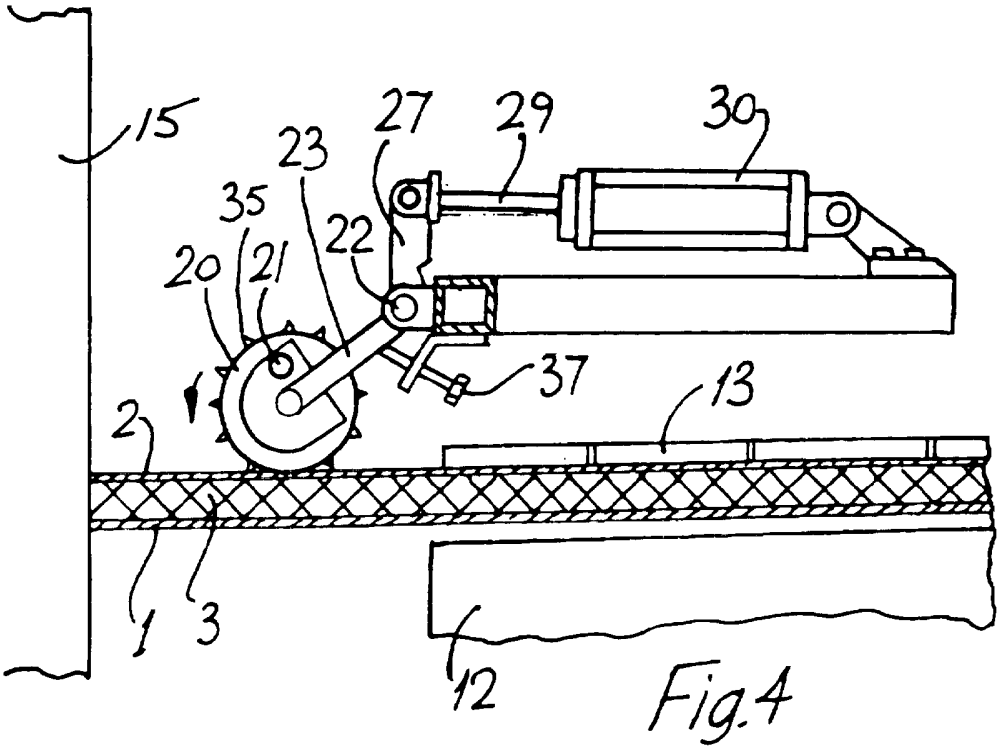

Fig.4

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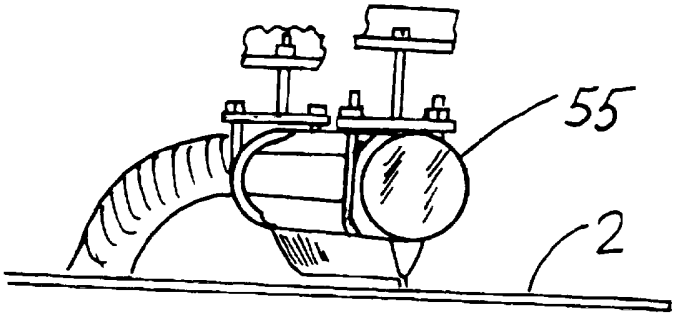

Fig.6

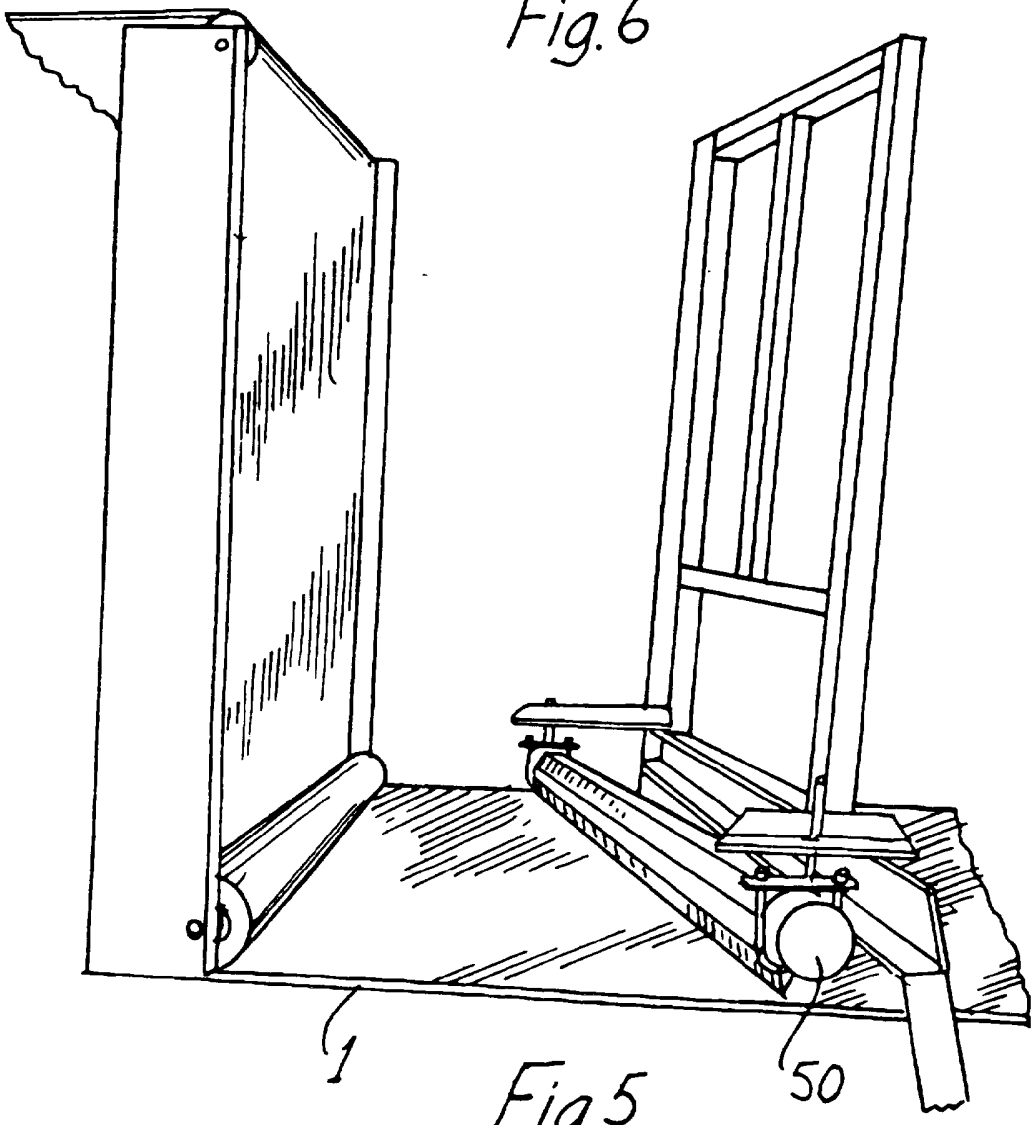

Fig.5

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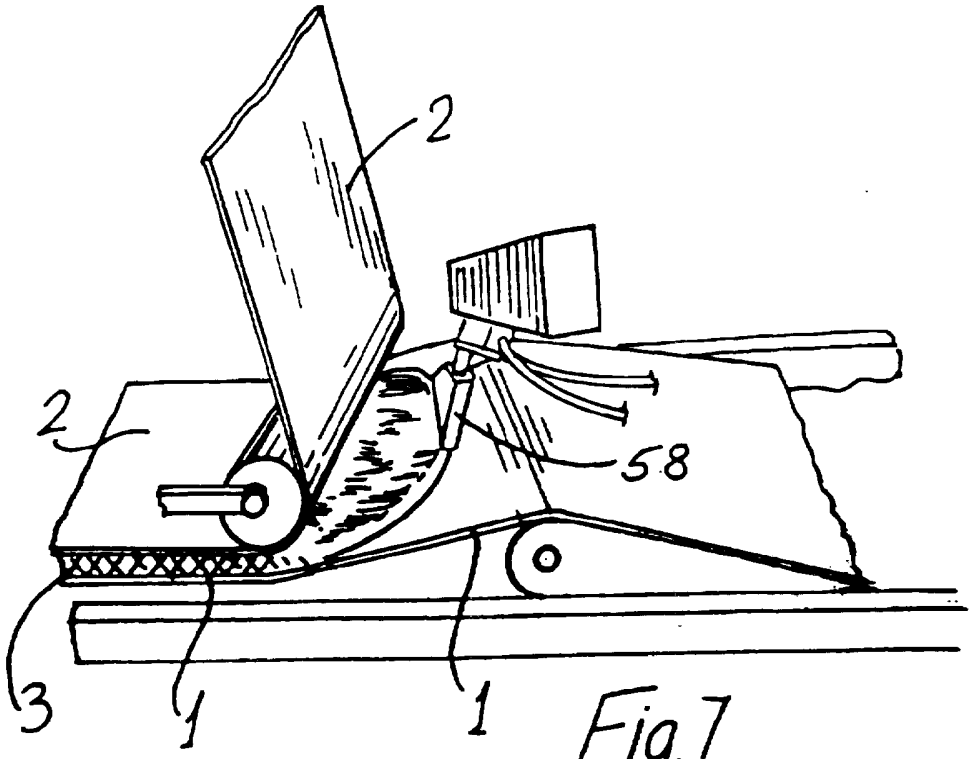

Fig.7

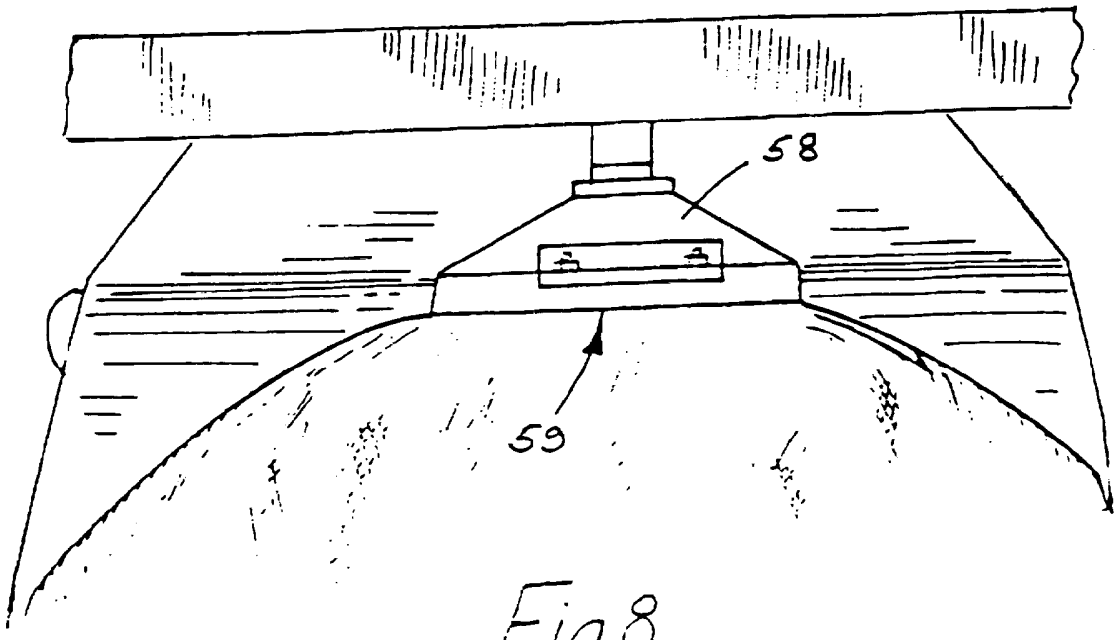

Fig.8

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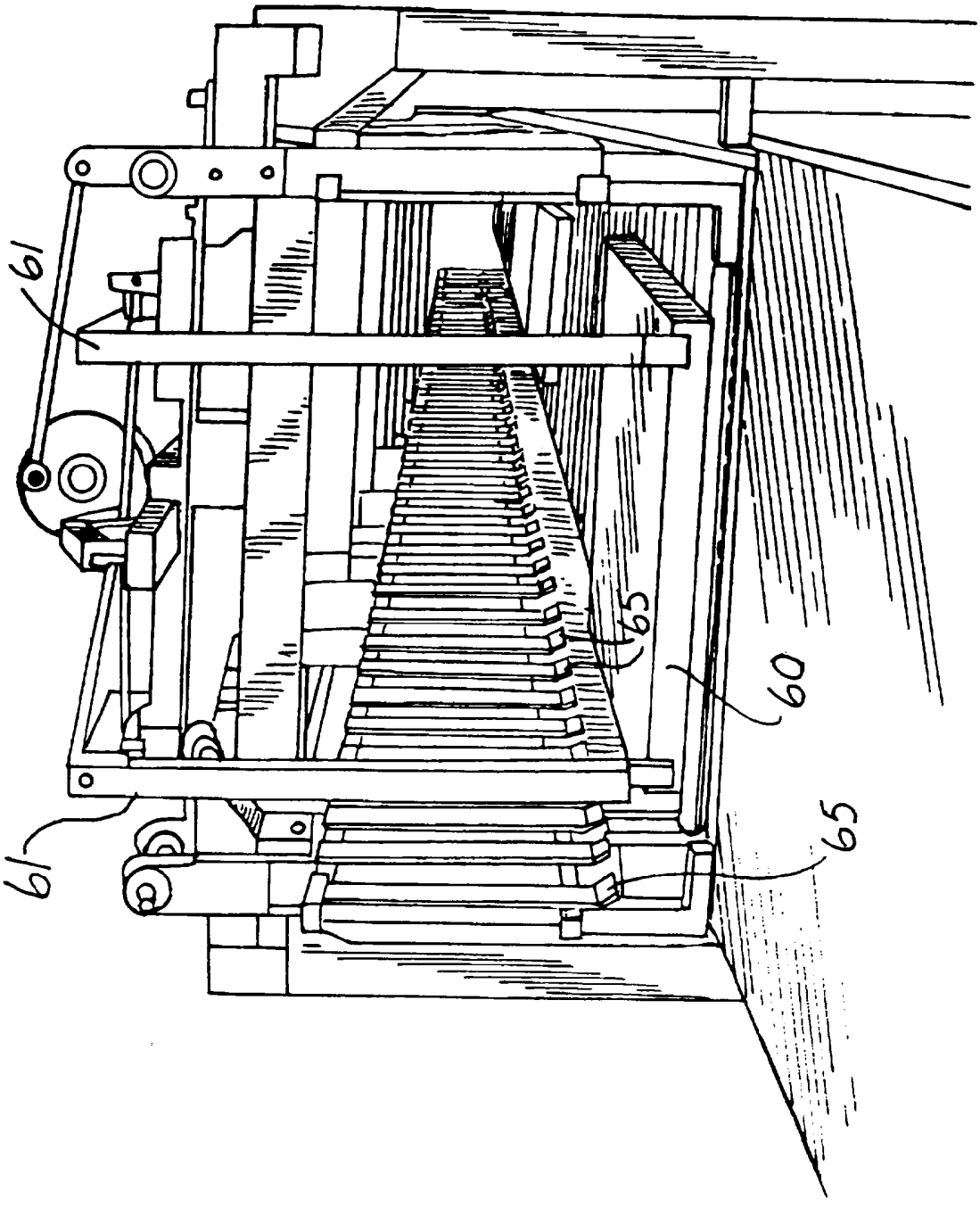
Fig. 9



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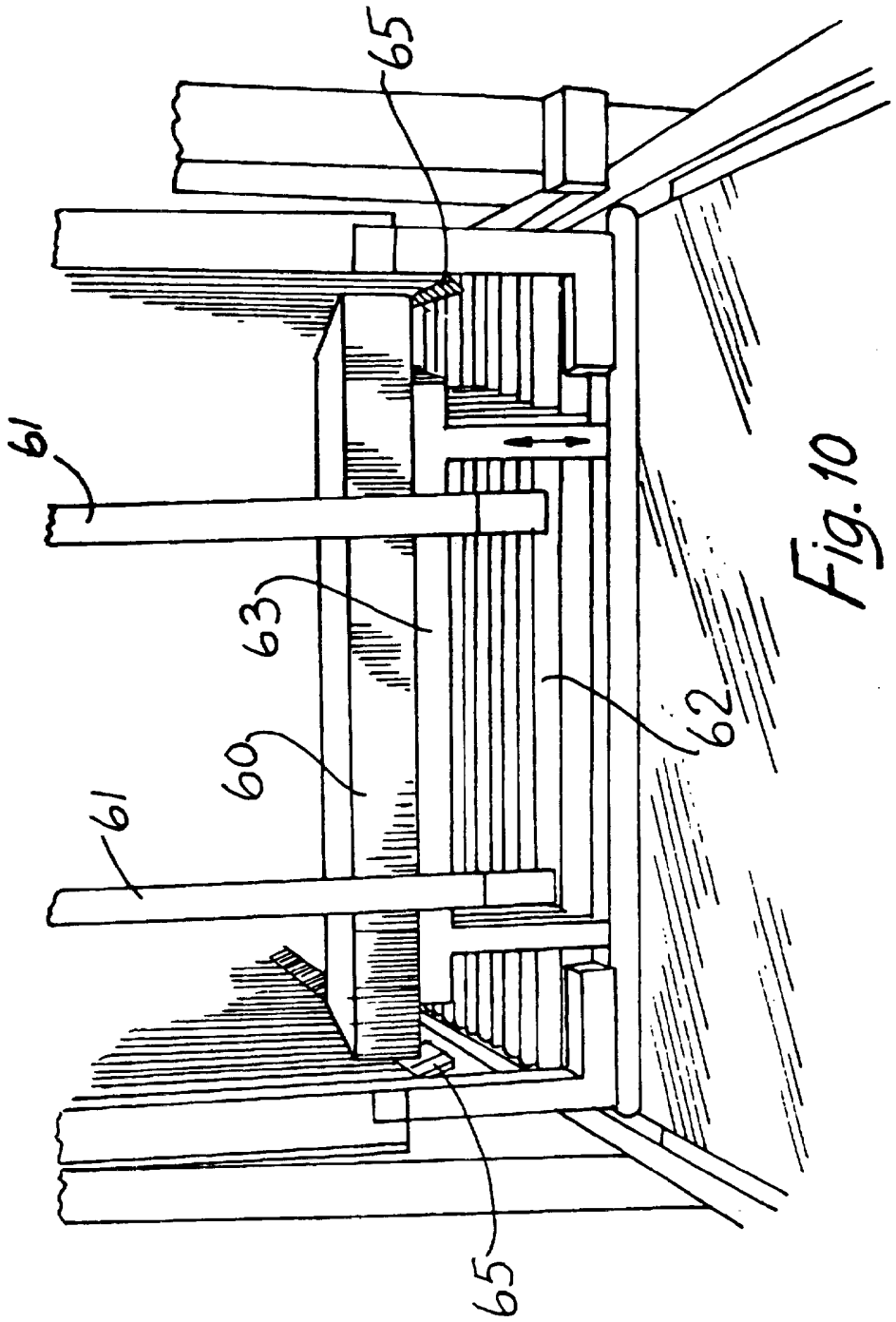
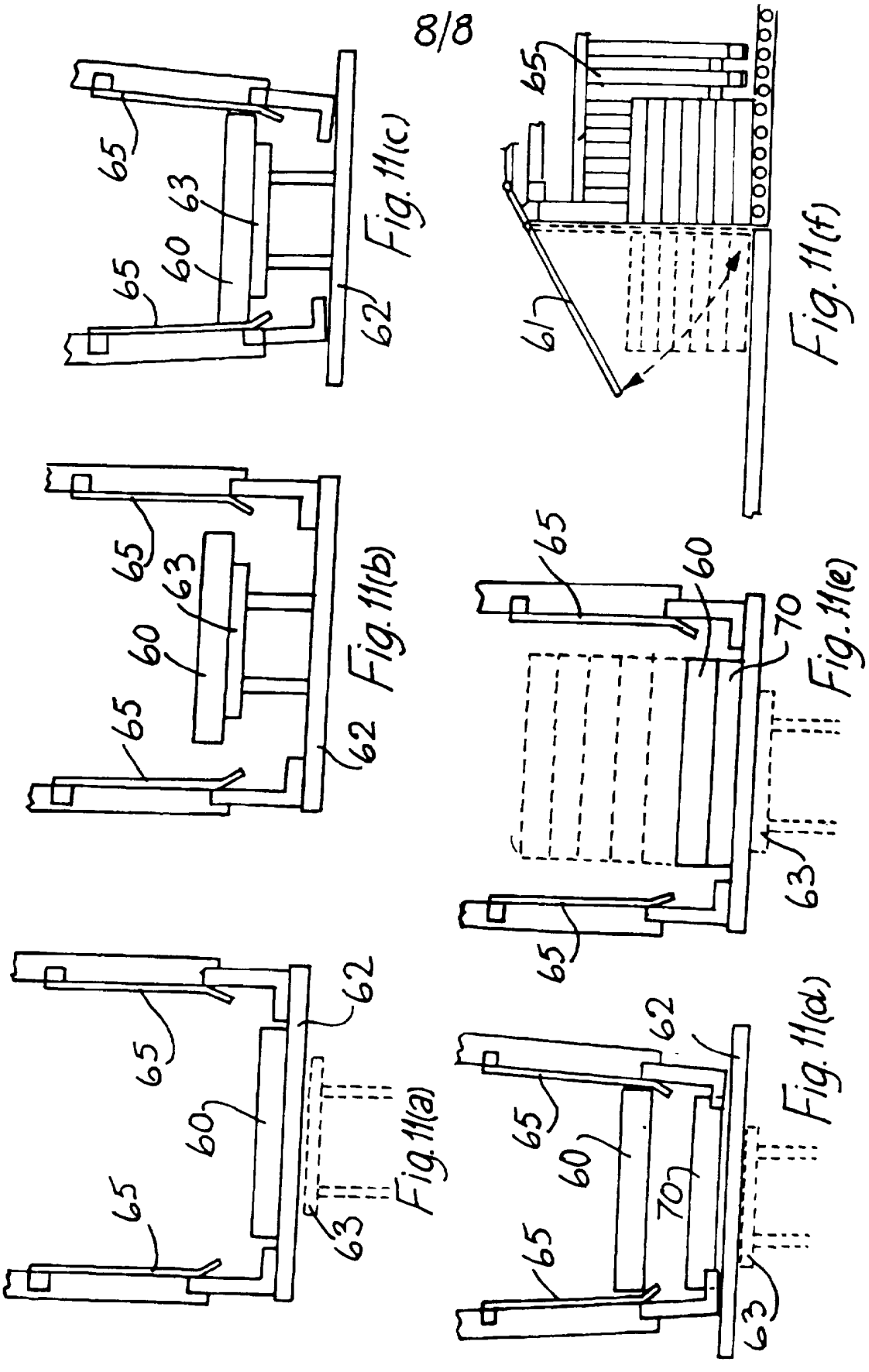


Fig. 10



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