

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199859742 B2
(10) Patent No. 736331

(54) Title
Moulding apparatus and system employing the same

(51)⁷ International Patent Classification(s)
B29C 039/10 B29C 044/18
B29C 039/12 B29C 044/38
B29C 044/06

(21) Application No: **199859742**

(22) Application Date: **1998.02.13**

(87) WIPO No: **WO98/36890**

(30) Priority Data

(31) Number	(32) Date	(33) Country
PO5211	1997.02.19	AU

(43) Publication Date : **1998.09.09**

(43) Publication Journal Date : **1998.11.05**

(44) Accepted Journal Date : **2001.07.26**

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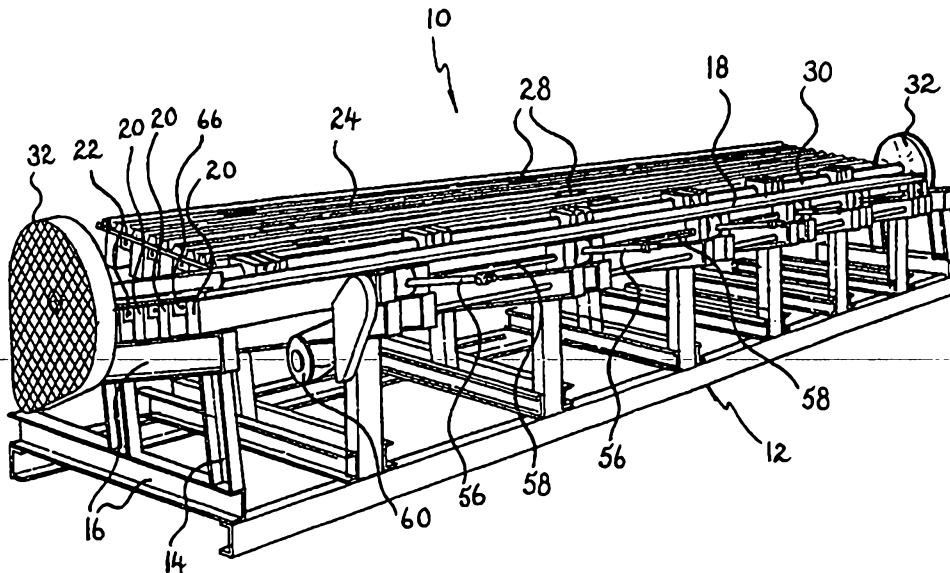
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(56) Related Art
US 4012186
WO 89/00496



<p>(51) International Patent Classification ⁶ : B29C 39/10, 39/12, 44/06, 44/18, 44/38 // B29L 31/10</p>	<p>A1</p>	<p>(11) International Publication Number: WO 98/36890 (43) International Publication Date: 27 August 1998 (27.08.98)</p>
<p>(21) International Application Number: PCT/AU98/00093 (22) International Filing Date: 13 February 1998 (13.02.98) (30) Priority Data: PO 5211 19 February 1997 (19.02.97) AU (71) Applicant (for all designated States except US): E.P.S. AUSTRALIA PTY. LTD. [AU/AU]; 23 Richardson Street, South Perth, W.A. 6151 (AU). (72) Inventors; and (75) Inventors/Applicants (for US only): MASSEY, John, Richard [AU/AU]; 5 Purdie Avenue, Ardross, W.A. 6153 (AU). SMEE, Daniel, Ross [AU/AU]; 33 Fitzroy Road, Rivervale, W.A. 6103 (AU). (74) Agents: HARWOOD, Errol, John et al.; Wray & Associates, 239 Adelaide Terrace, Perth, W.A. 6000 (AU).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i></p>

(54) Title: MOULDING APPARATUS AND SYSTEM EMPLOYING THE SAME



(57) Abstract

A moulding apparatus for manufacturing panels of sandwich configuration having at least three layers, the layers being a first and a second outer layer and a layer of cured filling therebetween, the moulding apparatus comprising a first means for receiving the first outer layer and a second means for receiving the second outer layer, at least one of said first and second means being adapted for movement relative to the other from a first position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel, the apparatus further comprising the sealing means to seal the apparatus when in the second or closed position.

Title: Moulding Apparatus and System Employing the Same**Background**

The present invention relates to a moulding apparatus and in particular to a moulding apparatus for the manufacture of sandwich panels with a foam filling, 5 such as polyurethane, the sandwich panels being capable of use to form the roof, floors and/or walls of buildings. The invention also relates to a system for manufacturing the sandwich panels using the moulding apparatus.

Moulds of various forms are presently available and have been in widespread use for many years. However, the moulds presently available are not 10 particularly suitable for the manufacture of sandwich panels with a foam filling such as polyurethane, that can function as structural members. Furthermore, prior art moulds lack versatility in that they are not suited to manufacturing panels with adequate weather sealing capabilities, when fitted, and/or overhanging outer layers that enables the panels to be conveniently and 15 aesthetically joined end to end and/or side to side, as required. More particularly, prior art moulds are not adapted to form an adequate seal during the curing process.

The present invention seeks to provide a moulding apparatus that overcomes or at least partially alleviates the abovementioned difficulties.

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Summary of the Invention

The present invention provides a moulding apparatus for manufacturing panels of sandwich configuration having at least three layers, the layers being a first and a second outer layer and a layer of cured filling therebetween, the moulding apparatus comprising a first means for receiving the first outer layer and a 25 second means for receiving the second outer layer, at least one of said first and second means being adapted for movement relative to the other from a first

position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel, the apparatus further comprising a sealing means to seal the
5 apparatus when in the second or closed position.

Throughout this specification, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising" will be understood to imply the inclusion of a stated integer or group of integers, but not the exclusion of any other integer or group of integers including method steps.

- 10 The first and second means may be of various forms and their shape and configuration is at least partially dependent on the form and profile of the outer layers which they are to receive. Preferably, the first and second means are provided by frame or tray members which define a surface upon which the outer layers may be received.
- 15 The nature of the movement of the first and second means may be varied provided they are adapted for relative movement to allow the outer layers to be applied to the apparatus and positioned to allow for the delivery of filling to the void between the outer layers. Preferably, one of the first or second means is fixed and the other is adapted for movement. For example, the first means, may
20 be fixed and the second means may be adapted for movement. Alternatively, the reverse may apply. In yet another alternative, both the first and second means may be adapted for movement.

Thus, the present invention also provides a moulding apparatus for manufacturing panels of sandwich configuration having at least three layers, the
25 layers being a first and a second outer layer and a layer of cured filling therebetween, the moulding apparatus comprising a first tray member being fixed and adapted to receive the first outer layer and a second tray member being moveable and adapted to receive the second outer layer, the movement of the second tray member being relative to the first tray member and from a first

position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel, the apparatus further comprising a sealing means to seal the
5 apparatus when in the second or closed position.

The tray members may be varied. When the outer layers are corrugated, the profile of the surface of at least one the tray members which is to receive the outer layer may be compatible with the profile of the outer layer so that the outer layer may sit flush with the surface of said tray member. Alternatively, at least
10 one of the tray members may define a substantially flat surface to receive the outer layer. In one particular form, one of said tray members defines a corrugated surface to receive the outer layer and the other tray member defines a substantially flat surface.

The angle of the outer layers during the curing process has been found to be
15 important to optimise the curing and bonding of the filling to the outer layers and thus the formation of the panels. Of course, the angle of the outer layers during the curing process may vary depending on the particular filling used and the dimensions of the panels manufactured. In this respect, the angle of the outer layers during the curing process must allow for gas, such as air, to be expelled
20 during the curing process. Thus, in general, the deeper the profile of the outer layers the greater the angle to the horizontal will need to be to allow for gas
~~bubbles to escape and ensure that the filling bonds adequately to the outer~~
layers. If the air is unable to escape the filling in the resulting panels may include air bubbles which would clearly be undesirable.

25 Thus, when the first tray member is fixed and the outer layer to be received thereon is corrugated, the first tray member may be inclined to the horizontal to allow for the filling to cure and bond to the layers thus forming the panel.

Preferably, the first tray member is inclined such that the outer layer is presented at an angle of at least approximately 8° - 10° to the horizontal. In an alternative form the first tray member presents the outer layer at an angle of between approximately 10° and 30° to the horizontal.

- 5 Preferably, and when the outer layers incorporate a relatively shallow corrugation, such as 24mm, a first tray member at an angle of approximately 8° - 15° to the horizontal may be appropriate. Alternatively, and when the outer sheets include a relatively deep corrugation the angle of the outer layers in the third position may be at an angle of approximately 30° to the horizontal.
- 10 In one particular example, when the filling is polyurethane such as a mixture of Polyol (blend of ethoxylated glycols and additives) and diphenylmethane-4,4-di-isocyanate and the panels are of dimensions 760mm by 100mm and include relatively shallow corrugations of approximately 24mm an angle of approximately 10° is preferred.
- 15 The apparatus may be adapted to manufacture panels of varying lengths as required. Thus, the first tray member may be adapted to receive at least one sizing element to enable panel of varying sizes to be manufactured in the apparatus. The sizing element may be varied and in one form comprises an insert that is locatable in the first tray member and is adapted to form a seal
20 between the outer layers at a point intermediate to the ends of the apparatus, when the apparatus is in the closed position.

The sizing element described above also enables the moulding apparatus to simultaneously manufacture a plurality of panels of various sizes as required.

- 25 The second tray member may also be varied as required and its configuration is at least partly dependent on the configuration of the first tray member. When the second tray member is moveable it may be further comprise a counterweight to improve its ease of movement. Preferably, the counterweight comprises at

least one weighted arm member that is mounted on the second tray member and extends laterally therefrom. Even more preferably, the counterweight comprises a plurality of weighted arm members spaced at equal distances along the second tray member.

- 5 The movement of the second tray member may be effected by a variety of means. Preferably, the second tray member is adapted for pivotal movement about a shaft that is operably connected to a drive such that on rotation of the shaft the second tray member is caused to move to close or open the apparatus as required.
- 10 When the second tray member is moveable it may further comprise a locating means that positively locates the outer layer on the surface of the tray member. The locating means may be varied and preferably is provided by a magnet, such as an electro-magnet that can be activated as required. Alternatively, and particularly when the outer layers are formed of a non-magnetic material, the
- 15 locating means may comprise a vacuum means that is fitted to the tray member.

The locating means provides for the positive location of the outer layer on the second tray member, preventing it from dislodging during the movement of the second tray member. Alternatively, or in addition to, and if necessary, the locating means may also be fitted to the first tray member.

- 20 The locating means may also assist in the release of finished panels from the apparatus. In this respect, when the locating means is a vacuum means it may also be capable of applying a positive air pressure to unseat or loosen the panel from the tray member thus facilitating its removal from the apparatus.

- 25 The sealing means may be varied provided it is adapted to seal the apparatus when in the second or closed position. Preferably, the sealing means comprises a plurality of abutment members that are adapted to form a seal at the edges of the outer layers.

The abutment members may be of various forms provided they are capable of forming a seal as required. Preferably, the abutment members comprise a first set adapted to form a seal at the ends of the outer layers and a second set adapted to form a seal at the sides of the outer layers.

- 5 Preferably, at least one of the abutment members adapted to form a seal at the side of the outer layers also includes an injection port through which the filling may be delivered to the void between the outer layers. The injection port may be varied as required and preferably includes a cover that enables the port to be open and closed as required.
- 10 The abutment members may be adapted for movement and thus may be driven by hydraulics or any other mechanism that enables them to move in and out of engagement with the edges of the outer layers.

- Preferably, the first set of abutment members are mounted on the first tray member and the second set are mounted on the second tray member to be
- 15 engageable with their sides and ends of the outer layers when the apparatus is closed.

- To further improve the seal provided by the abutment members, the abutment members may further comprise a resilient gasket member that is adapted to locate and seal between the abutment member and the outer layers. The gasket
- 20 member can be formed of any material that has suitable resilient characteristics and is preferably formed of rubber with a steel back and is shaped to be compatible with the profile of the outer layers. In one particularly preferred form the resilient gasket member further comprises at least one magnet to enable it to be releasably positioned in the moulding apparatus.

- 25 The sealing means may further comprise a lock down means for improving the seal during the curing process. The lock down means may be varied and preferably comprises a plurality of bolt members provided on the first tray

member that are receivable in compatible bracket members on the second tray member.

The bolt members may be moveable and in this regard may include a cam portion that enables them to apply a clamping force to the tray members in the
5 second position. Preferably, the cam portion is operatively connected to a drive means that enables the cam portion to be rotated to apply and release the clamping force as required.

The sealing means may further comprise at least one resilient member that is positioned and configured to further improve the seal between the outer layers
10 during the curing process.

Preferably, the resilient member comprises a resilient conduit provided and located proximal to the side edges of the outer layers between the base and surface of the second tray member. Alternatively, resilient conduits may be provided in both the tray members.

15 Preferably, the resilient conduits comprise hose members that are adapted to receive a fluid, such as air, and expand to impart pressure on the outer layers and further improve the seal between the outer layers during the curing process.

Alternatively, the resilient members may comprise resilient stopping members that are positioned and configured to further improve the seal between the outer
20 layers during the curing process. When the resilient members comprise resilient stopping members they do not require inflation and form a seal on contact with the outer layers. Of course, a combination of resilient conduits and resilient stopping members may be used in the apparatus.

The panels made using the apparatus of the present invention may be
25 manufactured using a filling which is supplied in liquid form and subsequently expands to a foam like consistency. The curing process in which the liquid filling expands to a foam and binds to the outer layers is at least partially dependent

on temperature. Thus, the apparatus of the present invention may further comprise a temperature control means.

The temperature control means may be of various forms. Preferably, the temperature control means is provided as part of the first and/or second means.

5 In this respect, and when the first and/or second means are provided by tray members, the temperature control means may comprise a heating or cooling element or the like provided integrally with at least one of said members.

Alternatively, the temperature control means may comprise a jacket which is provided integrally with at least one of the first and second means. The jacket
10 may be adapted to carry water or some other fluid to cool or heat the apparatus as required.

In one particular form, the jacket is provided as a conduit, or a plurality of conduits, passing through the first and/or second means. Preferably, the conduits are provided in both the first and second means and the water or other
15 fluid of predetermined temperature is circulated from an external source to adjust the temperature of the apparatus during the curing process to ensure optimum panel formation.

The present invention also provides a system for manufacturing a sandwich panel the system comprising a moulding apparatus for manufacturing panels of
20 sandwich configuration having at least three layers, the layers being a first and a second outer layer and a layer of cured filling therebetween, the moulding apparatus comprising a first means for receiving the first outer layer and a second means for receiving the second outer layer, at least one of said first and second means being adapted for movement relative to the other from a first
25 position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel, the apparatus further comprising a sealing means to seal the

apparatus when in the second or closed position and the system further comprising a filling delivery apparatus.

The filling delivery apparatus may be varied and preferably includes a boom and nozzle that is adapted to deliver filling to the void between the outer layers when
5 the moulding apparatus is in the closed position. Even more preferably, the filling delivery apparatus is adapted for movement relative to the moulding apparatus such that filling may be delivered to the moulding apparatus at a number of points along its length.

In one particular form, the filling delivery apparatus is mounted on tracks to be
10 moveable. Alternatively, the filling delivery apparatus may include wheels to facilitate its movement.

The present invention also provides a moulding apparatus for manufacturing panels of sandwich configuration having at least three layers, the layers being a first and a second outer layer and a layer of cured filling therebetween, the
15 moulding apparatus comprising a first means for receiving the first outer layer and a second means for receiving the second outer layer, at least one of said first and second means being adapted for movement relative to the other from a first position at which the outer layers may be applied to the apparatus, through a second position at which the filling may be introduced between said outer
20 layers, to a third position at which said outer layers are disposed to allow for the filling to cure and bond said outer layers together to form the panel.

The present invention will now be described with reference to the attached figures which illustrate one embodiment of the present invention. The description of the figures is by no means to limit the generality of the preceding
25 description.

Description of the Drawings

In the figures;

Figure 1 is a perspective view from above of a moulding apparatus according to a first embodiment of the present invention. The apparatus is in the first or open position to receive the outer layers;

5 Figure 2 is a perspective view from the reverse angle of the apparatus shown in figure 1. The apparatus is in the second or closed position at which the fluid filling can be placed between the outer layers;

Figure 3 is the reverse angle of the apparatus shown in figure 1;

10 Figure 4 is an end view of the apparatus according to the first embodiment in the closed position and including an outer layer fitted to the first tray member;

Figure 5 is an opposite end view to that shown in figure 4;

Figure 6 is a perspective view of a system according to the present invention in use and employing an apparatus according to the first embodiment;

15 Figure 7 is detailed view of a portion of figure 6 showing the filling being introduced between the outer layers; and

Figure 8 is another detailed view of a portion of figure 6 showing an injection port.

20 The moulding apparatus according to the embodiment and depicted in the figures is suitable for the manufacture of building members such as roof panels, floor panels and wall panels having outer layers formed from steel skins and a filling of polyurethane expanded foam.

The apparatus of the embodiment allows for the manufacture of panels with overlapping outer layers that enables the panels to be conveniently joined. The

overlapping outer layers of the panels made using the embodiment, when fitted may also provide weather seals and gutter mounts to buildings and be aesthetically pleasing.

The apparatus generally indicated by the numeral 10, includes a base 12 made up of a plurality of vertical supports 14 and cross members 16. The upper most cross members support the first means for receiving an outer layer, in the form of a generally rectangular shaped first tray member 18, and are angled at approximately 10° to the horizontal causing the surface of the first tray member 18 to also present at approximately 10° to the horizontal.

10 The first tray member 18 is fixed, has a generally flat surface for receiving the outer layer and a plurality of reinforcing members 20 that are spaced laterally and extend the length of the first tray member 18. The first tray member 18 also includes a plurality of conduits 22 adapted to carry the fluid for the temperature control means, which is described more fully below. The conduits 22 are also
15 spaced laterally and extend the length of the first tray member 18.

The second means for receiving an outer layer is provided by a generally rectangular shaped second tray member 24 which is moveable and has a corrugated surface adapted to receive an outer layer with a compatible profile.

The second tray member 24 is counterweighted by a plurality of weighted arm
20 members 26 that are mounted on the second tray member 24 and extend laterally therefrom to ease its movement. The second tray member 24 also includes a locating means in the form of a plurality of electro-magnets 28 that are adapted to hold the outer layer in position when the second tray member 24 moves to close the apparatus 10.

25 The second tray member 24 is moveable via its operable connection to a shaft 30 that extends the length of the apparatus 10 and lies between the tray members 18, 24 when the apparatus 10 is open. The shaft 30 is operatively

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connected at each of its ends to a chain and sprocket arrangement housed in a safety casing 32 and driven by a motor 34. Operation of the motor 34 effects the movement of the second tray member 24 and allows the apparatus 10 to be opened and closed as required.

- 5 The apparatus 10 further comprises a sealing means for forming a seal between the edges of the outer layers to prevent filling escaping during the curing process. In the embodiment, the sealing means is provided by a plurality of moveable contact members, a pair of resilient conduits and a series of lock down members.
- 10 Figures 4 and 5 best depict the sealing means of the apparatus and are shown including the outer layers fitted to the apparatus 10 in the second or closed position and ready to receive the filling. The outer layers include an overhanging lateral edge spanning approximately $1\frac{1}{2}$ corrugations that enables a series of panels to be conveniently clipped together by forcing the opposed
- 15 edge of one panel into the space defined by the overhang in the neighbouring panel.

The contact members are adapted to form a seal at the ends and the sides of the outer layers when the apparatus 10 is in the second or closed position. The moveable contact members comprise end contact members 36, 38 and side

20 contact members 40, 42.

The end contact members 36, 38 are each operatively connected to a hydraulic ram 44 which is mounted at opposite ends of the first tray member 18 and moves the contact members 36, 38 in and out of sealing engagement with the end of the outer layers.

- 25 The side contact members 40,42 are mounted on the second tray member 24 via a series of hydraulic rams 46 which move the contact members 40, 42 in and out of sealing engagement with the sides of the outer layers. To improve the

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seal between the outer layers during the curing process, resilient gasket members (not shown) may also be employed to improve the seal formed between the contact members 36, 38 and the outer layers.

Side contact member 40 also includes injection ports in the form of apertures 48 to enable the filling to be introduced between the outer layers when the apparatus 10 is closed. Each aperture 48 has a cover 50 that enables the apertures 48 to be opened and closed as required.

The resilient conduits of the sealing means are provided by flexible hose members 52, 54 located adjacent to the side edges of the second tray member 24, between its corrugated surface and base, and extend the length of the second tray member 24. The hose members 52, 54 are connected to a fluid source (not shown) and introduction of fluid into the hose members 52, 54 causes them to expand, thus imparting pressure on the surface of the second tray member 24 and further improving the seal between the outer layers during the curing process.

The sealing means of the embodiment further comprises lock down members in the form of bolt members 56 mounted on the first tray member 18 via a cam (not shown) mounted on a shaft 58 operatively connected to a pair of chain and sprocket arrangements 60, located at opposite ends of the apparatus 10. The chain and sprocket arrangements 60 are each driven by a hydraulic ram 62, which allow the second tray member 24 to be locked down or released by the bolt members 56 as required.

The bolt members 56 are receivable in bracket members 64 mounted on the second tray member 24, when the apparatus 10 is closed. Once received in the bracket members 64 actuation of the hydraulic rams 62 causes the second tray member 24 to be locked down as required to further improve the seal between the outer layers during the curing process.

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The temperature control means in the embodiment is provided by conduits 22 that run the length of the first and second tray members 18, 24. Three laterally spaced conduits 22 are provided in each tray member 18, 24. The conduits 22 are adapted to receive fluid at a predetermined temperature from an external source via ports 66. Heat exchange between the fluid in the conduits 22 and the tray members 18, 24 controls their temperature.

To manufacture sandwich panels using the apparatus 10, the temperature control means is activated and water or some other fluid at a predetermined temperature is passed through conduits 22 to bring the apparatus up to working temperature. Then the outer layers are placed on the tray members 18, 24 when the apparatus is in the first or open position and the electromagnets 28 are activated. The end and side contact members 36, 38, 40, 42, are engaged (engagement of end contact members at this point is optional, they may be engaged after closing the apparatus) and the tray member 24 is then moved to close the apparatus 10. The apparatus is then further sealed by locking down the bolt members 56 and expanding the resilient hose members 52, 54.

Once sealed, filling from the filling delivery apparatus 68 is introduced into the moulding apparatus 10 via tubes 70 on boom 72 and nozzle 74 to apertures 48 and the curing process is allowed to proceed.

20 After curing the above sequence is essentially reversed and the complete panel is removed from the apparatus 10.

Further modifications and adaptations apparent to one skilled in the art are to be encompassed within the scope of the present invention.

THE CLAIMS defining the invention are as follows:

1. A moulding apparatus for manufacturing panels of sandwich configuration having at least three layers, the layers being a first and a second outer layer and a layer of cured filling therebetween, the moulding apparatus comprising
 - (a) a first means for receiving the first outer layer; and
 - (b) a second means for receiving the second outer layer; at least one of said first and second means being;
 - (i) adapted for movement relative to the other from a first position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel; and
 - (ii) adapted to receive at least one sizing element to enable panels of varying sizes to be manufactured in the apparatus;
 - (c) the apparatus further comprising a sealing means to seal the apparatus when in the second or closed position.
2. A moulding apparatus according to claim 1 wherein the wherein the sizing element comprises an insert that is locatable in the first tray member and is adapted to form a seal between the outer layers at a point intermediate to the ends of the apparatus, when the apparatus is in the closed position.
3. A moulding apparatus according to claim 1 or 2 wherein the first or second means is fixed and the other is adapted for movement.
4. A moulding apparatus according to claim 1 or 2 wherein both the first and second means are adapted for movement.



5. A moulding apparatus according to any one of claims 1 to 4 wherein the first and second means comprise frame or tray members that define a surface upon which the outer layers may be received.
6. A moulding apparatus according to any one of claims 1 to 5 wherein the first and second means are trays members, the first tray member is adapted to receive at least one sizing element to enable panels of varying sizes to be manufactured in the apparatus and the second tray member is adapted for movement relative to the first tray member from a first position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel.
7. A moulding apparatus according to claim 6 wherein at least one of the tray members defines a corrugated surface to receive the outer layer.
8. A moulding apparatus according to claim 6 or 7 wherein the first tray member defines a substantially flat surface to receive the outer layer and the second tray member defines a corrugated surface to receive the outer layer.
9. A moulding apparatus according to any one of claims 1 to 7 adapted to present the outer layers at an incline to the horizontal when the apparatus is in the second position.
10. A moulding apparatus for manufacturing panels of sandwich configuration having at least three layers, the layers being a first and a second outer layer and a layer of cured filling therebetween, the moulding apparatus comprising:
 - (a) a first tray member being fixed and adapted to
 - (i) receive and present the first outer layer at an incline to the horizontal; and
 - (ii) receive at least one sizing element to enable panels of varying sizes to be manufactured in the apparatus; and



(b) a second tray member being moveable and adapted to receive the second outer layer, the movement of the second tray member being relative to the first tray member and from a first position at which the apparatus is open and adapted to receive the outer layers, to a second position at which the apparatus is closed and is adapted to receive the filling in fluid form between said layers to cure and bond said layers together to form the panel, the apparatus further comprising a sealing means to seal the apparatus when in the second or closed position.

11. A moulding apparatus according to claim 10 wherein the first tray member is inclined such that the outer layer is presented at an angle of at least approximately 8° - 10° to the horizontal.
12. A moulding apparatus according to claim 11 wherein the first tray member is inclined such that the outer layer is presented at an angle of approximately 10° and 30° to the horizontal.
13. A moulding apparatus according to claim 10 wherein the first tray member is inclined such that the outer layer is presented at an angle of approximately 10° to the horizontal.
14. A moulding apparatus according to any one of claims 6 to 13 wherein the second tray member further comprises a counterweight to improve its ease of movement.
15. A moulding apparatus according to claim 14 wherein the counterweight comprises at least one weighted arm member that is mounted on the second tray member and extends laterally therefrom.
16. A moulding apparatus according to any one of claims 6 to 15 wherein the second tray member is adapted for pivotal movement about a shaft that is operably connected to a drive such that on rotation of the shaft the second tray member is caused to move to close or open the apparatus as required.



17. A moulding apparatus according to any one of claims 6 to 16 further comprise a locating means that positively locates the outer layer on the surface of the second tray member.
18. A moulding apparatus according to claim 17 wherein the locating means comprises a magnet, such as an electro-magnet.
19. A moulding apparatus according to claim 17 wherein the locating means comprises a vacuum means.
20. A moulding apparatus according to any one of claims 17 to 19 wherein the locating means is also fitted to the first tray member.
21. A moulding apparatus according to any one of claims 1 to 20 wherein the sealing means comprises a plurality of abutment members that are adapted to form a seal at the edges of the outer layers.
22. A moulding apparatus according to claim 21 wherein the abutment members comprise a first set adapted to form a seal at the ends of the outer layers and a second set adapted to form a seal at the sides of the outer layers.
23. A moulding apparatus according to claim 21 or 22 wherein at least one of the abutment members adapted to form a seal at the side of the outer layers also includes an injection port through which the filling may be delivered to the void between the outer layers.
24. A moulding apparatus according to claim 23 wherein the injection port includes a cover that enables the port to be open and closed as required.
25. A moulding apparatus according to any one of claims 22 to 24 wherein the first set of abutment members are mounted on the first tray member and the second set are mounted on the second tray member to be engageable with the sides and ends of the outer layers when the apparatus is closed.
26. A moulding apparatus according to any one of claims 21 to 25 wherein the abutment members further comprise a resilient gasket member that is



adapted to locate and seal between the abutment member and the outer layers.

27. A moulding apparatus according to claim 26 wherein the gasket member is shaped to correspond with the cross sectional profile of the outer layers and further comprises at least one magnet to locate it in the apparatus.
28. A moulding apparatus according to any one of claims 1 to 27 wherein the sealing means comprises a lock down means for improving the seal during the curing process.
29. A moulding apparatus according to claim 28, as appended to claims 6 to 27, wherein the lock down means comprises a plurality of bolt members provided on the first tray member that are receivable in compatible bracket members on the second tray member.
30. A moulding apparatus according to claim 29 wherein the bolt members are moveable and further comprise a cam portion that enables the bolt members to apply a clamping force to the tray members in the second position.
31. A moulding apparatus according to any one of claims 1 to 30 wherein the sealing means comprises at least one resilient conduit that is positioned and configured to further improve the seal between the outer layers during the curing process.
32. A moulding apparatus according to claim 31, as appended to claims 6 to 30, wherein the at least one resilient conduit comprises a pair of resilient conduits located proximal to the side edges of the outer layers between the base and surface of the second tray member.
33. A moulding apparatus according to claim 31 wherein the at least one resilient conduit is provided in both the tray members.
34. A moulding apparatus according to any one of claims 31 to 33 wherein the at least one resilient conduit comprises a hose member that is adapted to



receive a fluid and expand to impart pressure on the outer layers and further improve the seal between the outer layers during the curing process.

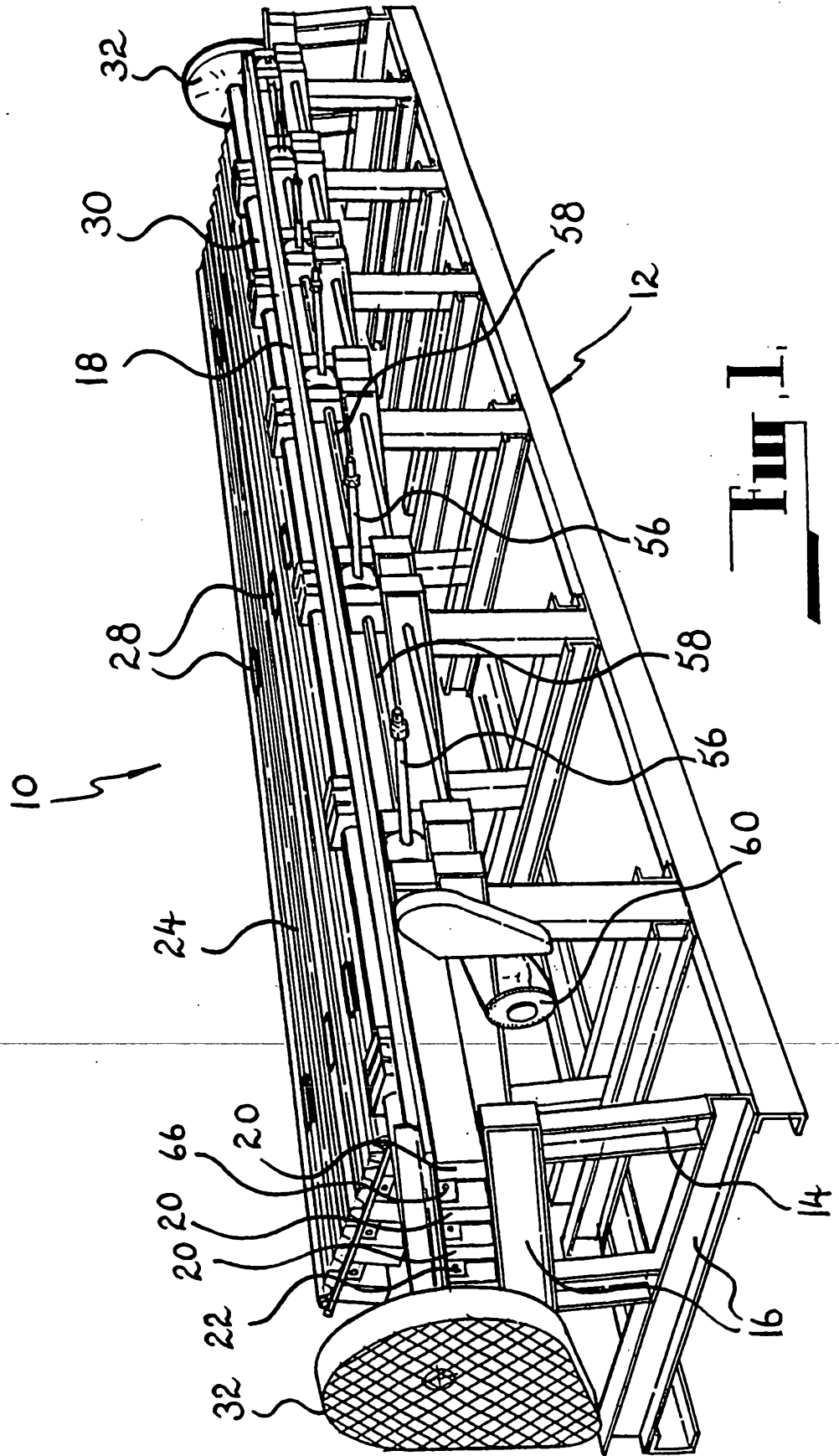
35. A moulding apparatus according to anyone of claims 1 to 34 further comprising a temperature control means.
36. A moulding apparatus according to claim 35 wherein the temperature control means comprises a heating element or the like provided integrally with at least one of the tray members.
37. A moulding apparatus according to claim 35 wherein the temperature control means comprises a jacket which is provided integrally with at least one of the tray members.
38. A moulding apparatus according to claim 37 wherein the jacket is provided as a conduit, or a plurality of conduits, passing through at least one of the tray members.
39. A moulding apparatus according to claim 38 wherein the conduits are provided in both the tray members and water or another fluid of predetermined temperature is circulated from an external source to adjust the temperature of the apparatus.
40. A system for manufacturing a sandwich panel the system comprising a moulding apparatus according to any one of the preceding claims and a filling delivery apparatus.
41. A system according to claim 40 wherein the filling delivery apparatus includes a boom and nozzle that is adapted to deliver filling to the void between the outer layers when the moulding apparatus is in the closed position.
42. A system according to claim 40 or 41 wherein the filling delivery apparatus is adapted for movement relative to the moulding apparatus such that filling may be delivered to the moulding apparatus at a number of points along its length.



43. A moulding apparatus substantially as herein described and with reference to the figures.

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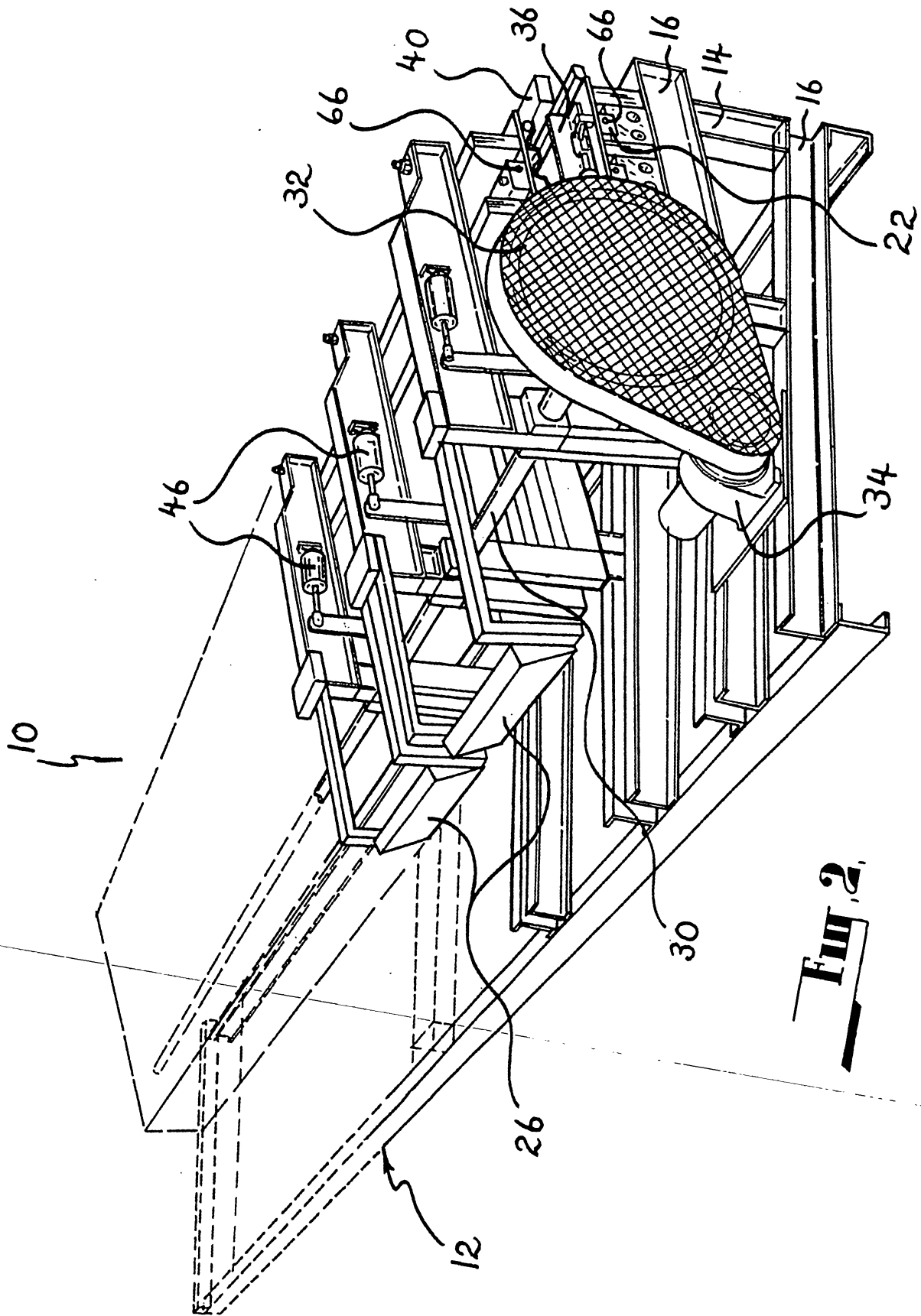


Fig. 2

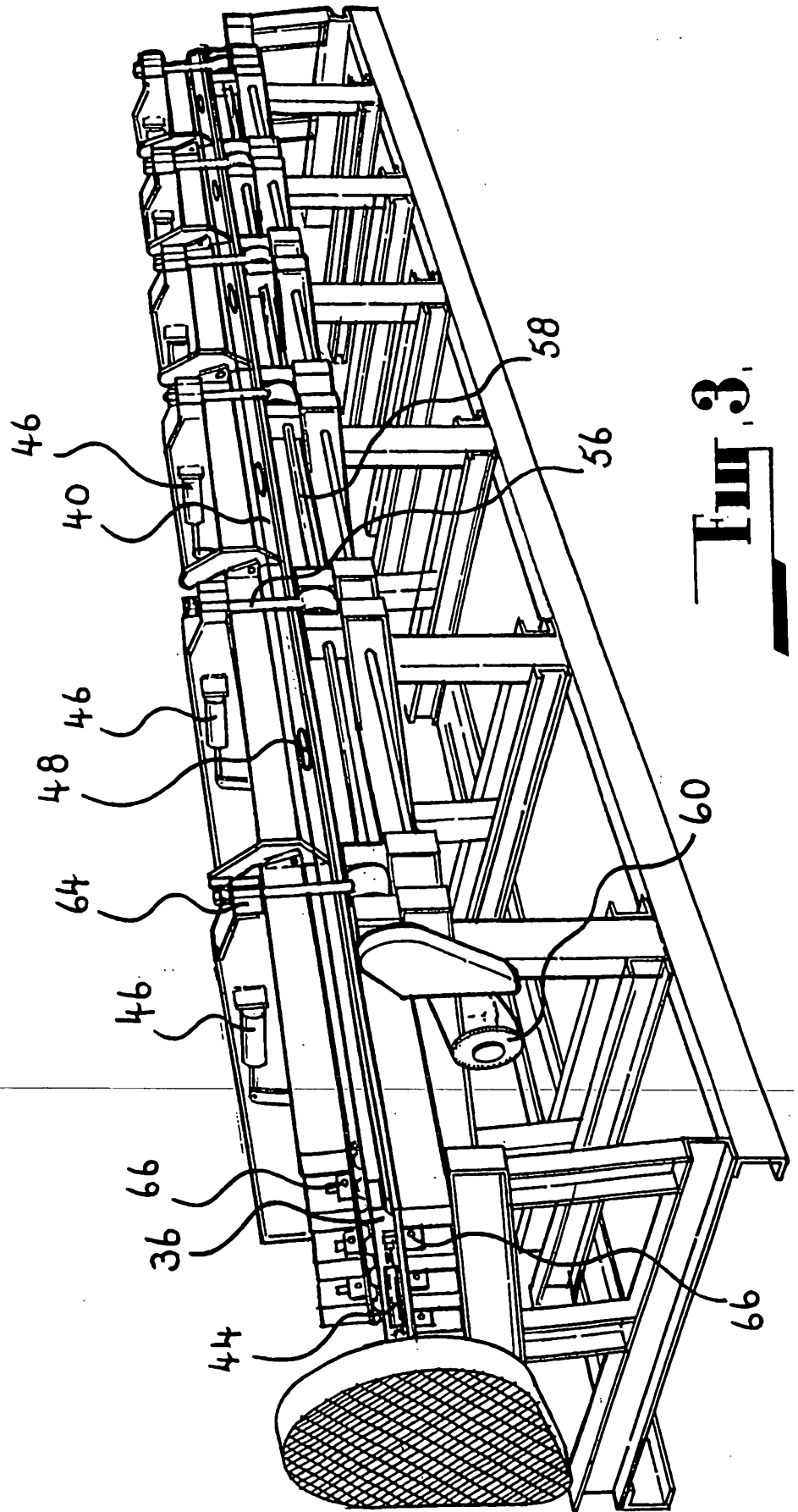


Fig. 3

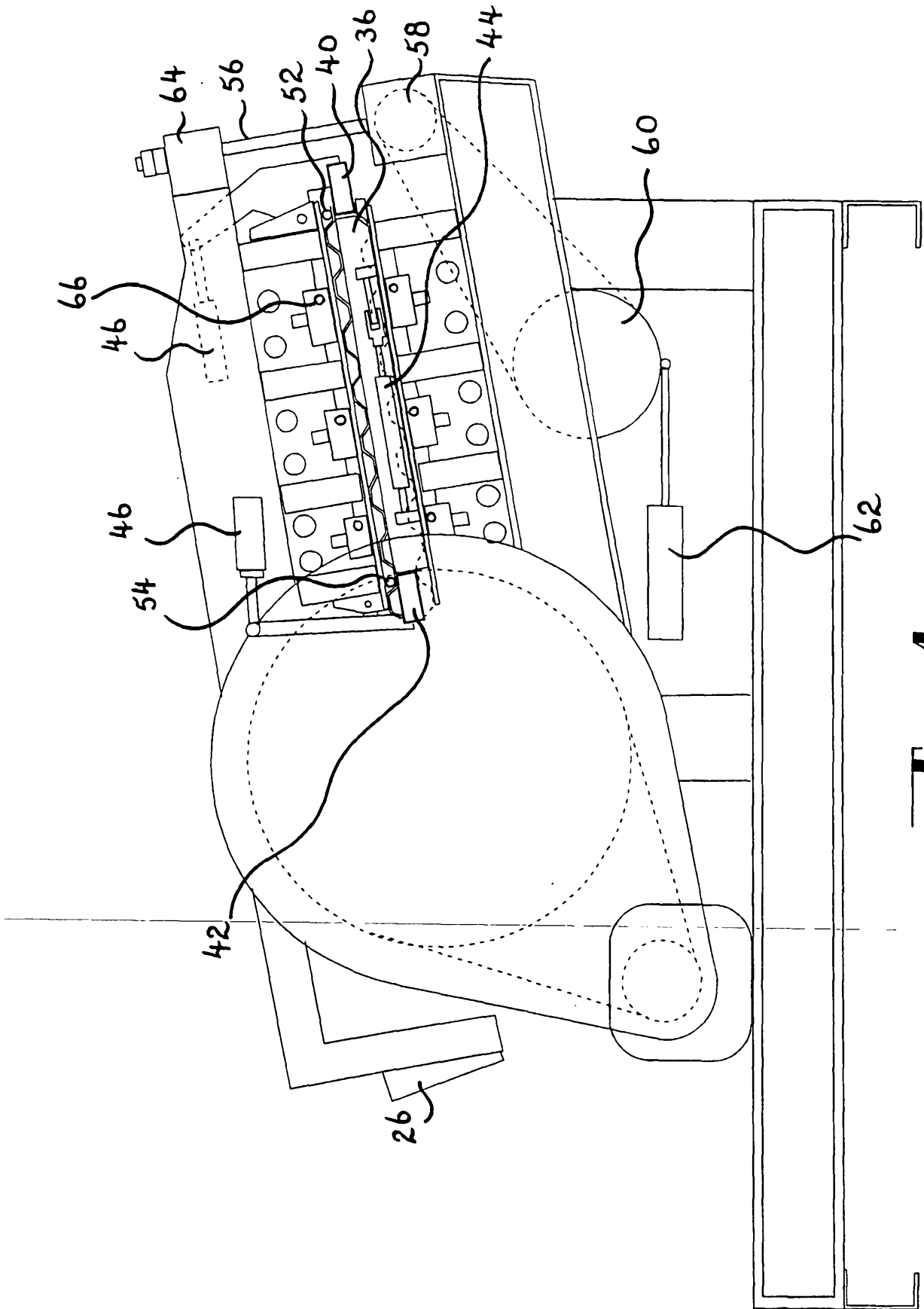


Fig. 4

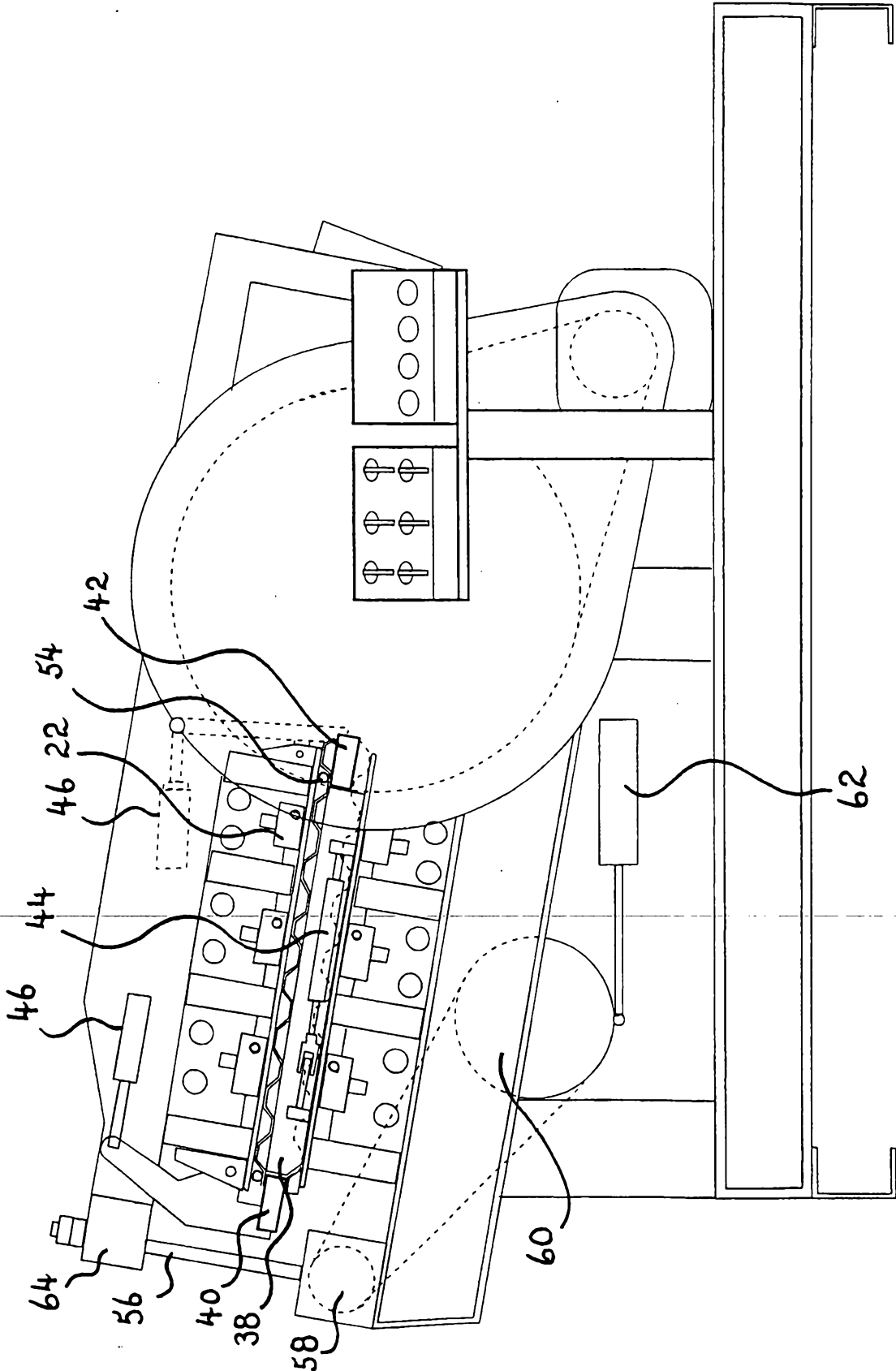


Fig. 5

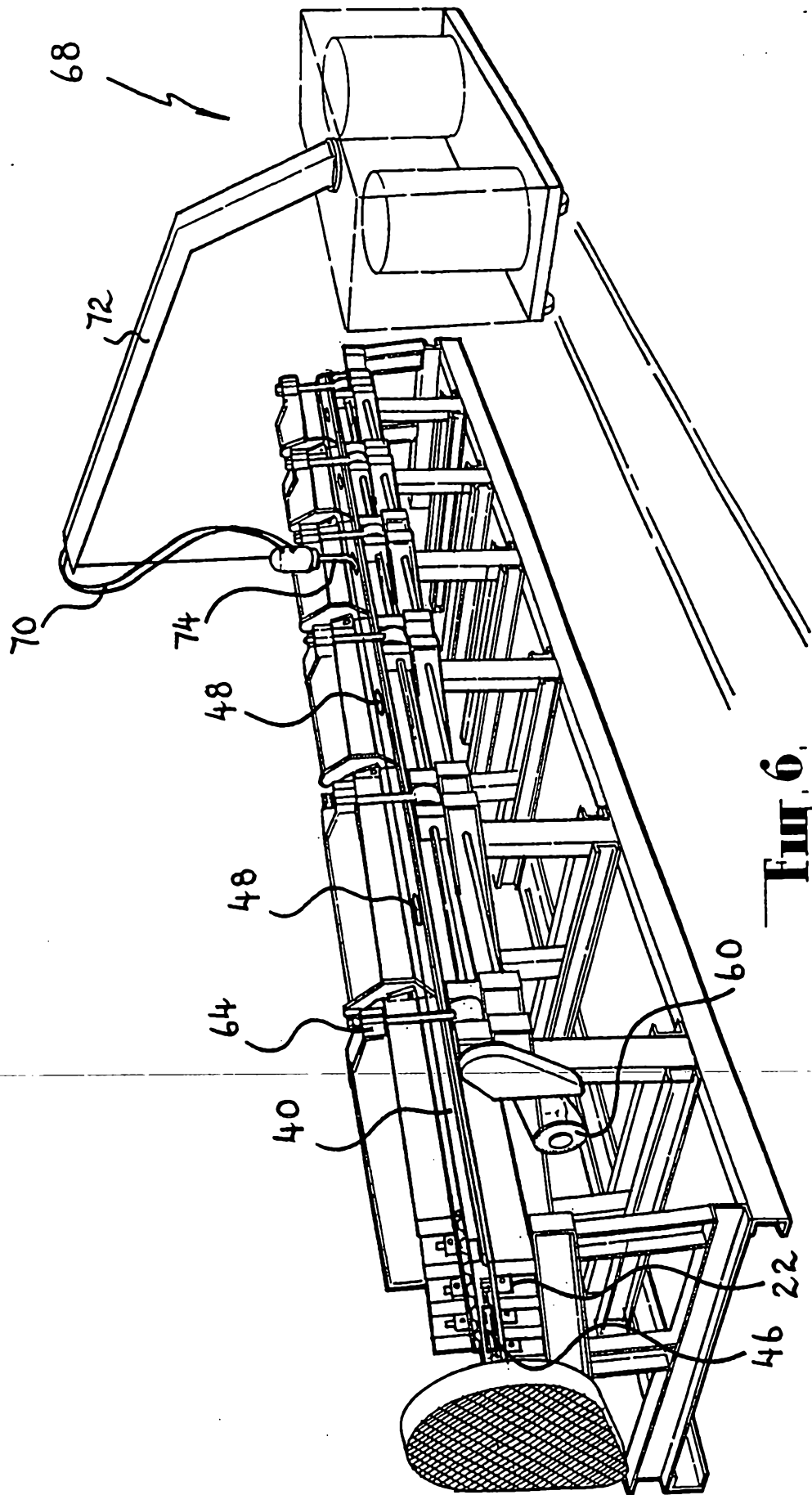


FIG. 6

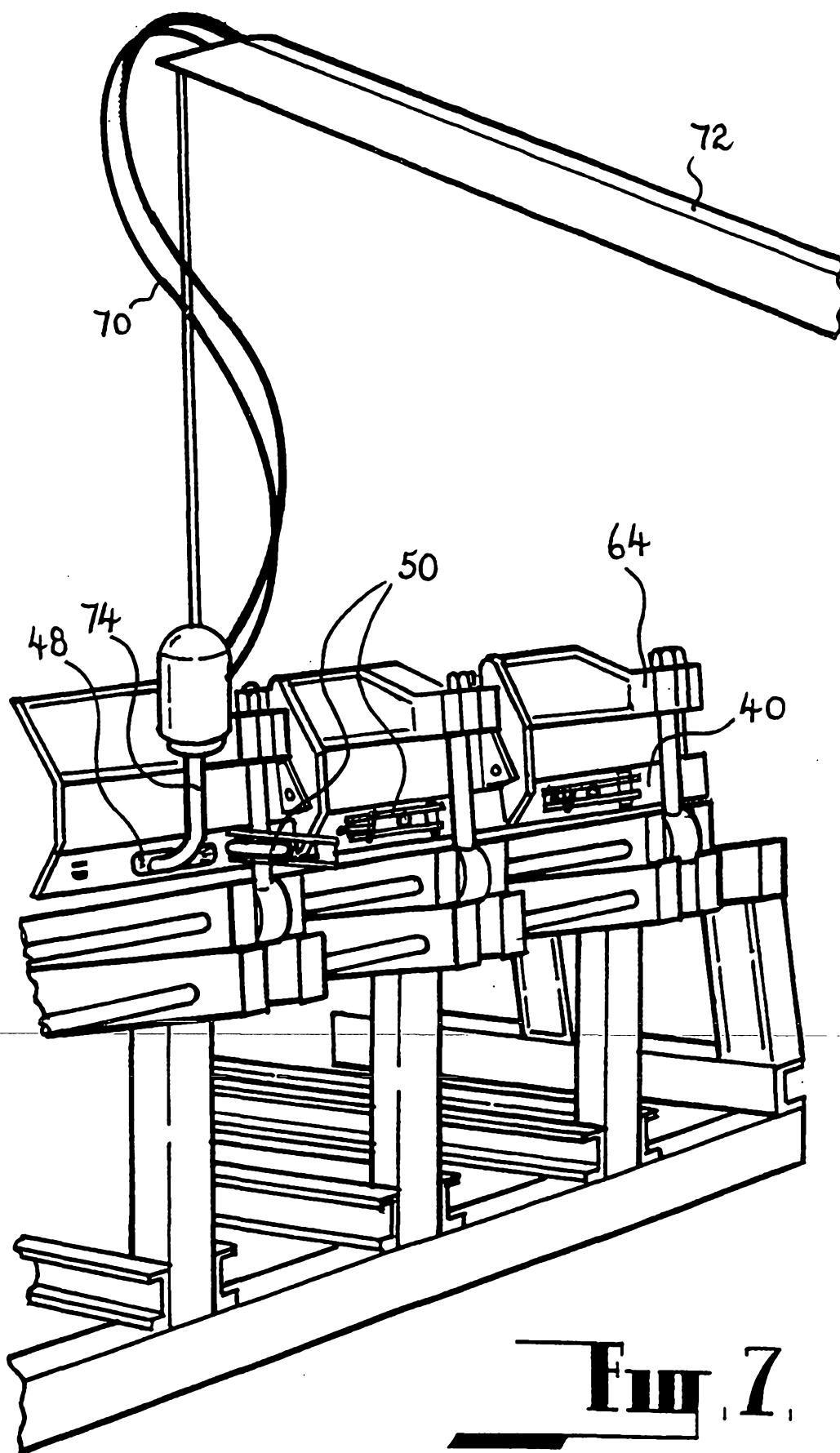


Fig. 7.

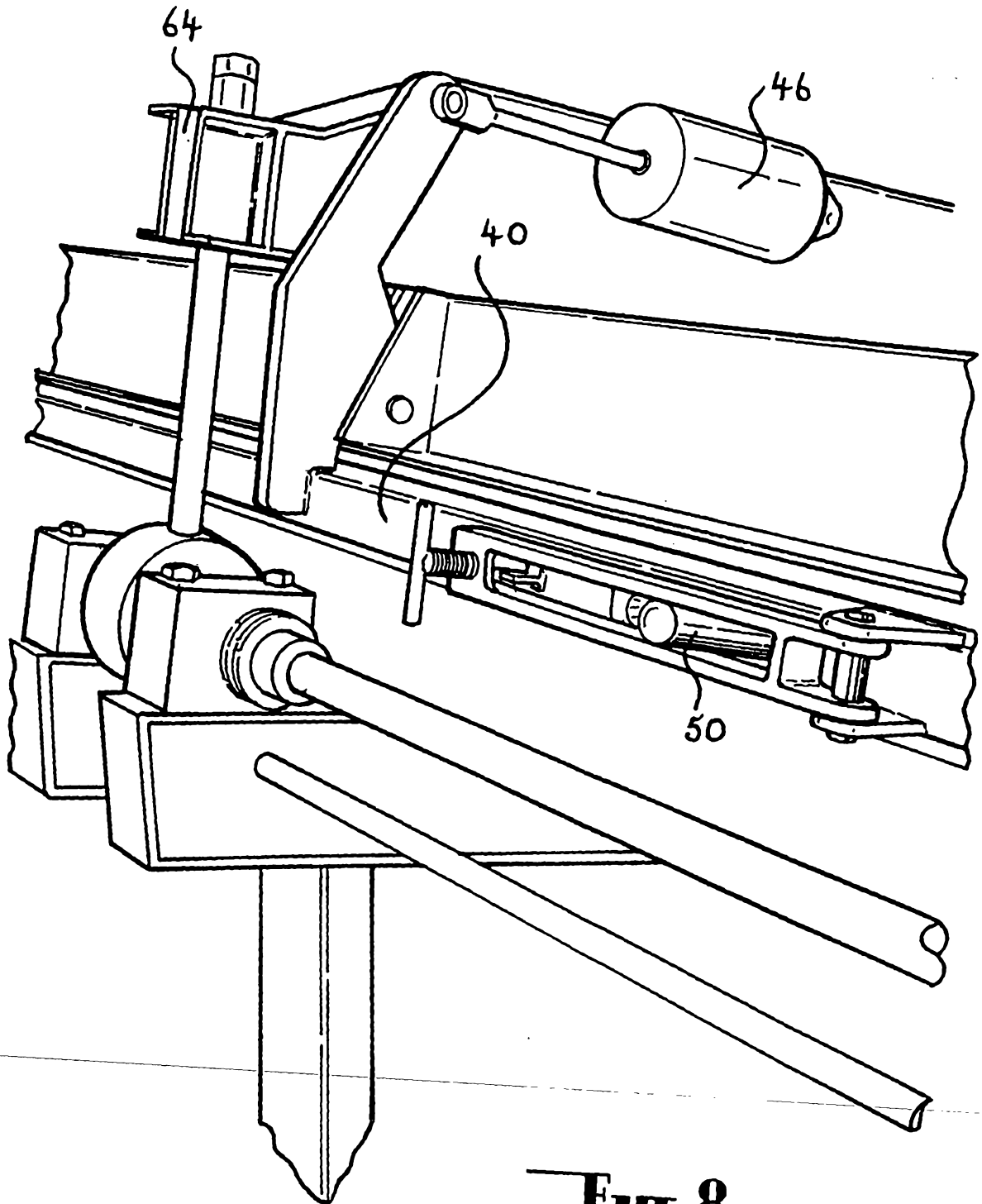


Fig. 8.