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(54) **Method and device for manufacturing building elements.**

(57) A method of manufacturing a building element intended to erect walls of a building whereby first a plate-shaped part of the building element of brick-like material is made and a sheet of insulating material is fixed to one side of said plate-shaped part.

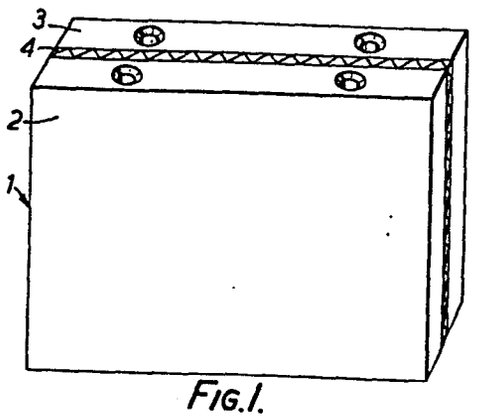


FIG.1.

EP 0 103 936 A2

# METHOD AND DEVICE FOR MANUFACTURING BUILDING ELEMENTS.

The invention relates to a method of manufacturing building elements intended for erecting a wall of a building.

For erecting a wall of buildings are often used plate-shaped parts of brick-like material such as sand-lime bricks, sand-lime blocks, plate-shaped sand-lime brick elements, concrete bricks, concrete blocks, plate-shaped concrete elements or similar materials. Such plate-shaped, parts of brick-like material are mostly manufactured in given sizes in a factory.

When erecting the walls of buildings by means of such plate-shaped parts severe requirements have to be met by thermal insulation with regard to saving of energy and by sound insulation with regard to minimize sound nuisance.

Moreover is is necessary to meet the general requirements with respect to fire prevention, whilst in the event of calamities health and environments must not be adversely affected due to the use of given materials.

Particularly separation walls between contiguous houses have to satisfy stringent requirements with respect to sound insulation. When structural requirements are correctly satisfied, a wall having a weight of 500 kgs per square metre provides a satisfactory sound insulation. A so-called anchor-less cavity wall, in which no connection is established between the two sides of the cavity wall, also ensures excellent sound insulation, but the construction of such an anchor-less cavity wall is comparatively expensive.

If a separation wall between contiguous houses has, in addition,

to satisfy requirements with respect to thermal insulation, additional precautions have to be taken, which involves additional costs.

With respect to front façades, back fronts and side façades forming outer walls sound insulation is, in general, of minor importance, but in contrast thereto, the thermal insulation has to fulfil considerably higher requirements. In the case of such façades it is, therefore, common practice to provide the inner part of the façade formed by a cavity wall with a thermal insulation which is applied to the inner part during the erection thereof. This is a time-consuming expensive operation, whilst the result highly depends on the care by which the insulating materials are applied to the inner plate.

The invention has for its object to provide a building element which is capable of meeting the requirements of thermal insulation and/or sound insulation, whilst with the aid of such a building element the erection of a wall can be performed at lower cost and more rapidly than with the aid of the classical building elements.

According to the invention this can be achieved in that first a plate-shaped part of the building element is made from brick-like material and a sheet of insulating material is fixed to one side of said plate-shaped part.

By using the method embodying the invention a prefabricated building element for walls comprising a brick-like, plate-shaped part can be obtained in a simple manner, in which in accordance with the invention a sheet of insulating material is fixed to the brick-like plate-shaped part. When the sheet of insulating material constitutes the outer layer of the building element, such a building element can be very effectively used for erecting the inner part of a cavity wall forming an outer façade. It is no longer necessary to apply the thermal insulation separately on the building site to the cavity wall, which results in appreciable saving of cost, whilst it is ensured that the insulating material is present in a correct manner at any place.

When the sheet of insulating material is fixed between two layers of brick-like material the resultant building element is suitable for erecting a monolith separation wall between contiguous houses, in which case a minimum structural thickness ensures optimum sound insulation. When erecting

such a monolith wall as compared to an anchor-less cavity wall 50 % less profiles have to be set up, whilst in addition an operational run i.e. the erection of part of a wall is not required and fewer struts for resisting wind load need be applied and the further process is simpler owing to the larger wall thickness. It will be obvious that this method will result in considerable cost saving in the construction.

Compared with a single heavy wall a wall formed by prefabricated building elements embodying the invention has the advantage of being of lighter weight so that the foundation cost may be reduced.

A further aspect of the invention relates to a device for manufacturing building elements of the kind set forth.

According to the invention the device comprises a table with an adjustable stop on which alternately plate-shaped parts of brick-like material and sheet of insulating material can be deposited and a setting cylinder arranged opposite said stop.

In such a device a plurality of plate-shaped parts and sheets of insulating material can be deposited on the table and be pressed one against the other with the aid of the setting cylinder to obtain optimum fixation.

The invention will be described more fully hereinafter with reference to the accompanying Figures.

Fig. 1 is an elevational view of a building element embodying the invention in a perspective view.

Fig. 2 is a plan view of the element of Fig. 1.

Fig. 3 is a side elevation of the element of Fig. 1.

Fig. 4 is a perspective view of a second building element embodying the invention.

Fig. 5 is a plan view of the element of Fig. 4.

Fig. 6 is a side elevation of the element of Fig. 4.

Fig. 7 is a schematic elevational view of a wall erected by using building elements embodying the invention.

Fig. 8 is a sectional view of a separation wall between two contiguous houses obtained by using building elements embodying the invention.

Fig. 9 is a cross-sectional view of a wall forming a side façade obtained by means of building elements embodying the invention.

Fig. 10 is a schematic plan view of a device for manufacturing

building elements in accordance with the invention.

Fig. 11 is a sectional view of the device of Fig. 10 taken on the line XI-XI in Fig. 10.

Fig. 12 is a sectional view of the device of Fig. 10 taken on the line XII-XII in Fig. 10.

Fig. 13 is a sectional view of the device of Fig. 10 taken on the line XIII-XIII.

Fig. 14 is a sectional view of the device of Fig. 10 taken on the line XIV-XIV in Fig. 10.

As is shown in Fig. 1, a building element 1 may be formed by two plate-shaped parts 2 and 3, for example, of sand-lime brick or concrete and by a sheet 4 of insulating material sandwiched between said plate-shaped parts, preferably,polystyrene foam. Such building elements may have any desired length, width and thickness. In a similar manner a building element 5 may be formed by a single plate-shaped part 6 and a side face having a sheet 7 of insulating material, preferably, polystyrene foam fixed to it (Figs. 4 to 6).

From Fig. 7 it will be apparent that such building elements 1 or 5 can be used for erecting a wall or a façade, whilst if necessary given building elements can be sawn to measure, for example, to form a triangle as shown in Fig. 7 for the head of the wall illustrated in said Figure.

As is shown in Fig. 8 a separation wall between two contiguous houses is erected by means of building elements 1, the stacked building elements being fixed to one another with the aid of a special, thin joint mortar as employed for normal sand-lime brick elements. The mortar is dosed by means of a special mortar hod or mortar scoop so that the mortar is solely applied to the brick surface and will not get at the insulating material in order to avoid sound leakages resulting from contact bridges formed by mortar burls.

Fig. 9 furthermore shows that the elements 5 can be used in a similar manner for erecting the inner part of an outer wall, the outer part of which may be erected by means of conventional bricks 8 or the like.

As stated above, the insulating material is preferably formed by plate-shaped polystyrene hard foam. This material, which is fixed to the prefabricated plate-shaped parts of brick-like material, is specially worked

to ensure a flexible joint with the plate-shaped parts. For this purpose the polystyrene hard foam is made in the conventional manner in moulds with a volume-weight of 15 kgs/$m^3$. Then the resultant polystyrene foam blocks are rolled to a volume-weight of 17 kgs/$m^3$, after which with the aid of an electric filament plates of insulating material are cut to size from such blocks.

For the manufacture of the building elements described above the device shown in Figs. 10 to 14 can be effectively employed.

This device comprises two parallel conveyor paths 10 and 11 arranged side by side. The conveyor path 10 comprises a plurality of endless conveyor belts or chains 12, which can be driven in the direction of the arrow A by means of a driving member 13.

In a similar manner the conveyor path 11 comprises a plurality of endless chains or belts 12', which can be driven in the direction of the arrow B with the aid of a driving memeber 13''. Near one end of the two conveyor paths 10 and 11 a horizontal shaft 14 extends at right angles to the direction of length of the two conveyor paths 10 and 11, said shaft being reciprocatable through a given angle with the aid of a driving member 13'. The shaft 14 has fastened to it L-shaped arms 15. To these arms are secured carriers 16 and 17, which support freely rotatable rollers 18 and 19 respectively. The rotary axes of the rollers are located in vertical planes parallel to the direction of movement indicated by the arrow A, whereas the rotary axes of the rollers 18 are located in a plane orthogonal to the plane going through the rotary axes of the rollers 19.

At the level of the tilting device formed by the component parts 14 to 19 there is arranged a setting cylinder 20 comprising a reciprocatory stamp 21.

Near the tilting device a further setting cylinder 22 provided with a stamp 23 is arranged in line with the conveyor path 11.

Between the endless chains or belts 12' of the second conveyor path 11 tubes forming a tackle 24 are arranged parallel to said chains or belts 12' and connected with one another. These tubes can be moved up and down between a first position in which the top sides of the tubes are located at a higher level than the top sides of the top runs of the endless chains or conveyor belts 12' and a second position in which the top sides

of the tubes 24 are located at a lower level than the top sides of the conveyor belts or chains 12'.

Furthermore a carriage 26 can run on rails 25 extending below the conveyor belts or chains 12' in the direction of length of the second conveyor path 11. The carriage 26 serves to support a beam 27 serving as a stop and being located above the conveyor belts or chains 12', said beam normally extending at right angles to the direction of length of the conveyor path 11 and being pivotable through 360° in the direction of the arrow C about a pivotal shaft 27'.

Along one side of the first conveyor path 10 a stationary stop 28 extends along part of the length of the conveyor path 10. Along one side of the conveyor path 11 a fixed stop beam 29 covers part of the length of the conveyor path and on the other side of the conveyor path is arranged a guide and stop beam 30 in a resilient manner transversely of the direction of length of the conveyor path.

Near one end of the conveyor path 11 there is furthermore provided a gluing system 31 comprising spray nozzles 32 and 33 arranged one above and opposite the other.

The prefabricated plate-shaped parts 2 and 3 of brick-like material are passed with the aid of suitable transport means to the device described above and deposited on the lower end of the conveyor path 10, as viewed in Fig. 10, with the aid of a suitable grab system. This grab system deposits a predetermined amount of parts 2 and 3 on the conveyor path 10 as shown in Fig. 10. By actuating the endless conveyor belts or chains 12 these plate-shaped parts 2 and 3 are moved in the direction of the arrow A towards the tilting device. The rollers 18 and 19 of the tilting device are arranged so that the rollers 18 are horizontal and the rollers 19 are vertical. When a first plate-shaped part is in contact with the rollers 19, the rollers 18 and 19 are tilted backwards by the turn of the shaft 14 in the direction of the arrow D into the position shown in Fig. 12. Then the setting cylinder 20 is actuated so that the tilted element is urged by a stamp 21 to the right, as viewed in Fig. 10, into a position above the conveyor path 11. Subsequently the stamp 21 of the setting cylinder 20 is urged back and the tilting device is turned forwards to deposit the plate-shaped part 2 or 3 on the tubes 24, which are set in a position

in which the top sides of the tubes 24 are located at a higher level than the top sides of the upper runs of the conveyor belts or chains 12'.

Then by actuating the setting cylinder 22 with the stamp 23 the plate-shaped part can be pressed against the displaceable stop 27, which is disposed near the gluing system 31.

Near the gluing system is lying a stock 34 of insulating sheets cut to size. Whilst with the aid of the conveyor path 10 and the tilting device a second plate-shaped part 3 of brick-like material is supplied, a sheet of insulating material 4, as schematically shown in Fig. 10, is passed through the gluing system and subsequently deposited also on the frame formed by the tubes 24, that is to say, on the side of the plate-shaped part 2 first supplied facing the setting cylinder 22.

When elements of the kind shown in Figs. 1 to 3 have to be manufactured, the sheet of insulating material is provided on both sides with a layer of glue. After the sheet of insulating material thus provided on both sides with a layer of glue is deposited at the side of the plate-shaped part 2 already standing on the tubes 24, a further plate-shaped part 3 is pressed against the sheet of insulating material with the aid of the setting cylinder and the stamp 23. Subsequently a third plate-shaped part is supplied and after the deposition of this third plate-shaped part a further sheet of insulating material provided on both sides with glue layers and subsequently a fourth plate-shaped part, and so on are supplied. During the supply of the plate-shaped parts and the sheets of insulating material, which are advanced by the setting cylinder 22 and the stamp 23, the mobile stop is gradually pushed away until a package of a predetermined number of building elements has been formed. The mobile stop 27 has then arrived at a final position as shown in Fig. 10, after which the whole package is subjected to pressure by means of the setting cylinder 22, which is then used as a compressing cylinder. As soon as the desired pressure has been attained, the resultant package is firmly tied by strings 35, for example, steel tape, synthetic tape, special cords or the like. By means of these materials the package has to be firmly held in position to prevent shifts of the component parts during transport as long as the adhesive has not yet fully cured.

After the package is completed by applying the strings and the stamp 23 has moved back into its initial position, the stop 27 is turned

away and the tubes 24 are moved downwards, after which the package formed can be transported with the aid of the conveyor chains or belts 12' in the direction of the arrow B towards the position of such a package shown in Fig. 10. The stop 27 is further turned and moved back into its initial position so that the cycle described above for the formation of a package can be repeated. The package standing on the end of the conveyor path 11 can in the meantime be taken away with the aid of a grab system and be conducted away in a suitable manner. In order to avoid as far as possible shifts of the components during the curing process, which still has to take place partially, the packages are preferably deposited on strong, flat pallets. After sufficient curing the building elements can be worked further and, if required, cut to size before being supplied to the building site.

It will be obvious that for the manufacture of building elements as shown in Figs. 4 to 6 the process may be the same, but an adhesive layer will be applied only to one side of a sheet of insulating material with the aid of the gluing system. When forming the package it has to be ensured that the two outer layers of the package are formed by plate-shaped parts of brick-like material. This can be achieved by alternately supplying a plate-shaped part of brick-like material and a sheet of insulating material and by supplying only in the formation of the end of the package in order of succession two sheets of insulating material and a last plate-shaped part of brick-like material.

The figures used in the claims are only meant to explain more clearly the intention of the invention and are not supposed to be any restriction concerning the interpretation of the invention.

CLAIMS

1. A method of manufacturing a building element intended to erect walls of a building characterized in that first a plate-shaped part of the building element of the brick-like material is made and a sheet of insulating material is fixed to one side of said plate-shaped part.

2. A method as claimed in Claim 1 characterized in that a second plate-shaped part of brick-like material is fixed to the side of the sheet of insulating material remote from the first plate-shaped part of brick-like material.

3. A method as claimed in Claim 1 or 2 characterized in that the manufacture of the sheets of insulating material is based on polystyrene hard foam having a volume-weight of 15 kgs/$m^3$, which polystyrene hard foam is consolidated to a volume-weight of 17 kgs/$m^3$, after which the sheets of insulating material are cut to size from said consolidated material.

4. A prefabricated building element for the erection of walls comprising a plate-shaped part of brick-like material characterized in that a sheet of insulating material is fixed to the plate-shaped part of brick-like material.

5. A building element as claimed in Claim 4 characterized in that the sheet of insulating material constitutes the outer layer of the building element.

6. A building element as claimed in Claim 4 or 5 characterized in that the sheet of insulating material is sandwiched between two plate-shaped parts of brick-like material.

7. A building element as claimed in anyone of Claims 4 to 6 characte-

rized in that the insulating material is formed by polystyrene foam which is consolidated from a volume-weight of 15 kgs/$m^3$ to a volume-weight of 17 kgs/$m^3$.

8. A device for manufacturing building elements as claimed in anyone of the preceding Claims characterized in that the device comprises a table with adjustable stop, on which plate-shaped parts of brick-like material and sheets of insulating material can be alternately deposited and a setting cylinder disposed opposite said stop.

9. A device as claimed in Claim 8 characterized in that the table is formed by a frame displaceable in a direction of height and consisting of tubes or beams extending in the direction of displacement of the setting cylinder, the tubes or beams being located between endless conveyor members of a conveyor path and being displaceable from a position in which the beams or tubes are projecting above the top side of the conveyor path into a position in which they are located below the top face of the conveyor path.

10. A device as claimed in Claim 8 or 9 characterized in that the adjustable abutment can turn through an angle of 360° about a vertical pivotal shaft provided near one end of the abutment.

11. A device as claimed in anyone of Claims 8 to 10 characterized in that on both sides of the table stops extend in the direction of length of the table, one stop being stationary and the other stop being movable transversely of the direction of length of the table.

12. A device as claimed in anyone of Claims 8 to 11 characterized in that near one end of the table a gluing system is provided with opposite spray nozzles, between which a sheet of insulating material can be passed, whilst means are provided for actuating the spray nozzles in a manner such that a sheet of insulating material is provided only on one side or on both sides with an adhesive.

13. A device as claimed in anyone of the preceding Claims 8 to 11 characterized in that the device comprises two parallel conveyor paths and near one end of the two conveyor paths a tilting device extends over the whole width of the two conveyor paths and a setting cylinder extends transversely of the direction of length of the conveyor paths so that with the aid of said setting cylinder a building element standing on the tilting device can be displaced.

14. A device as claimed in Claim 13 characterized in that the tilting device comprises a plurality of sets of orthogonal rollers, the rotary axes of which are located in vertical planes extending in the direction of length of the conveyor paths.

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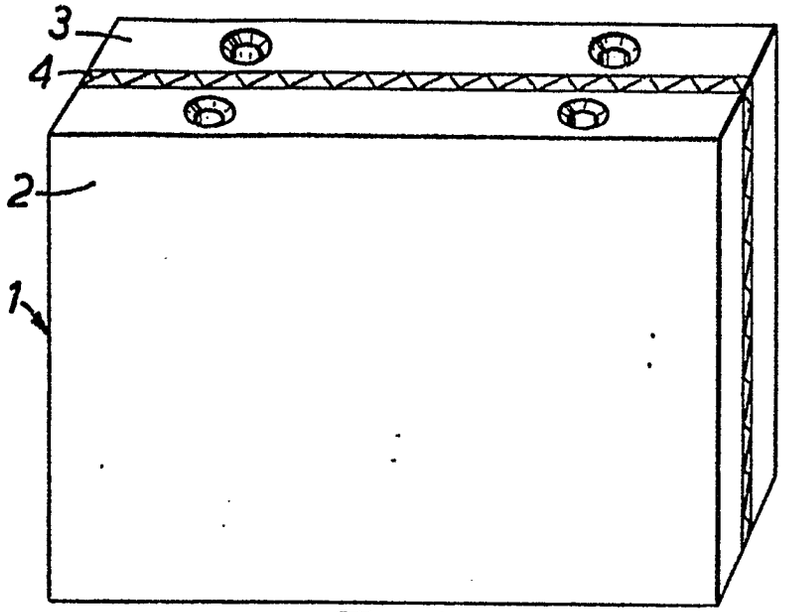


FIG.1.

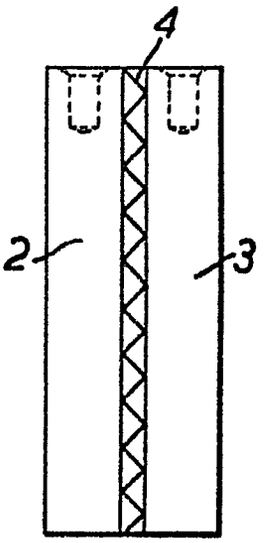


FIG.3.

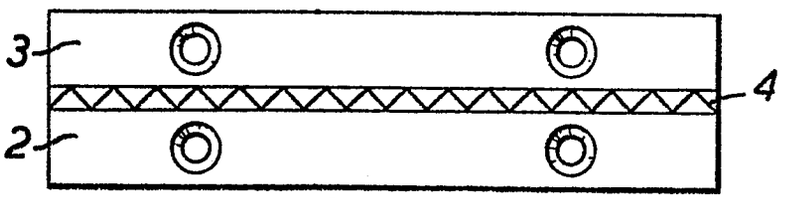


FIG.2.

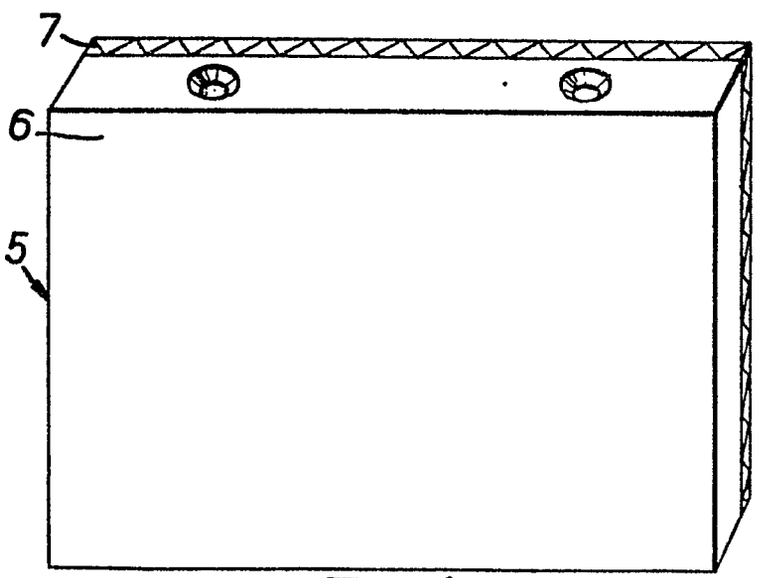


FIG.4.

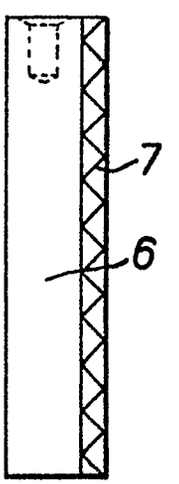


FIG.6.

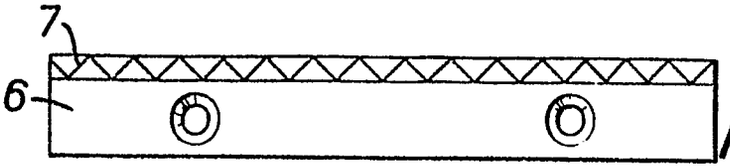


FIG.5.

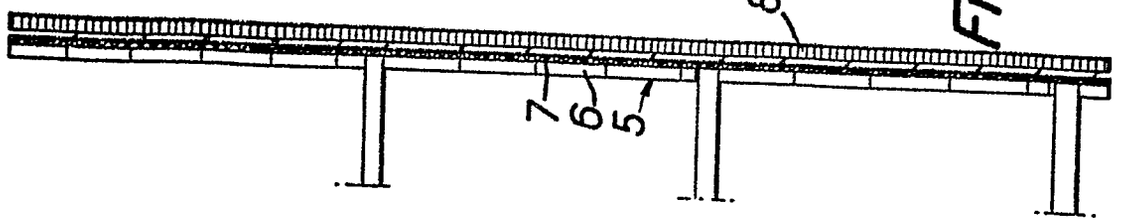


FIG.9.

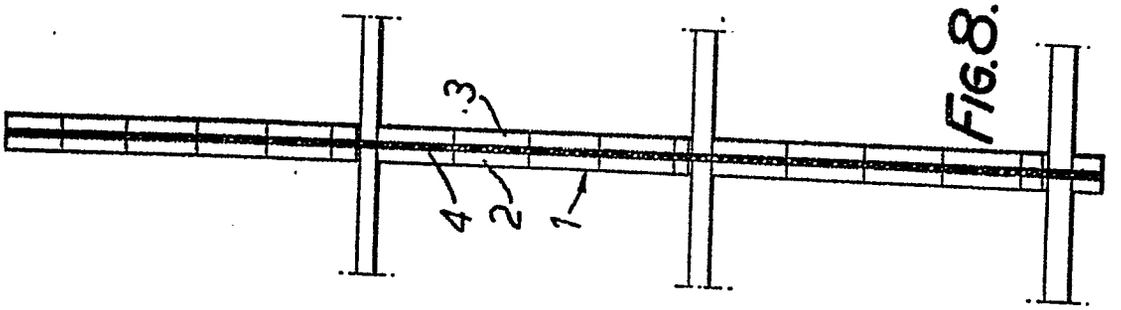


FIG.8.

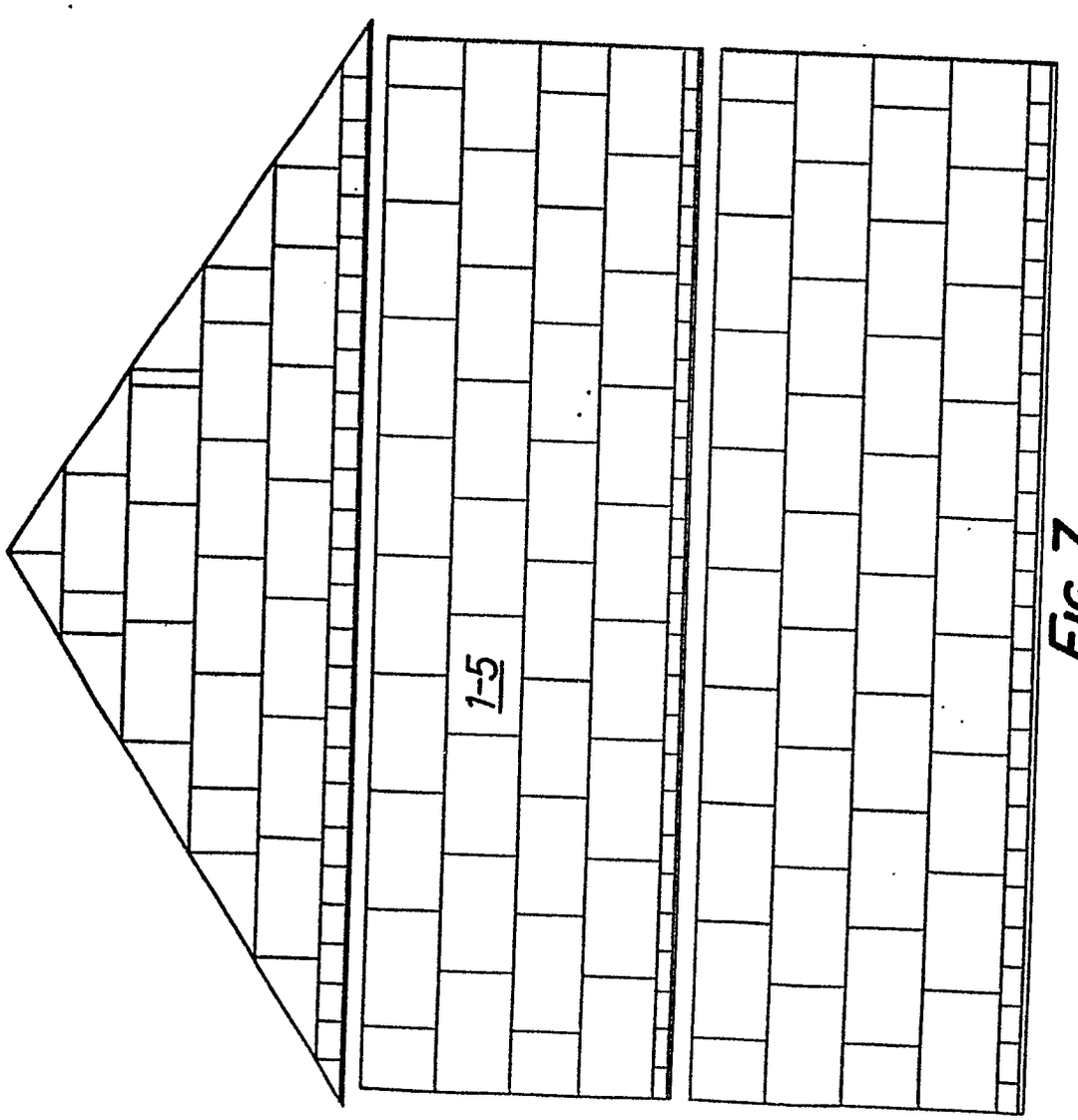


FIG.7.

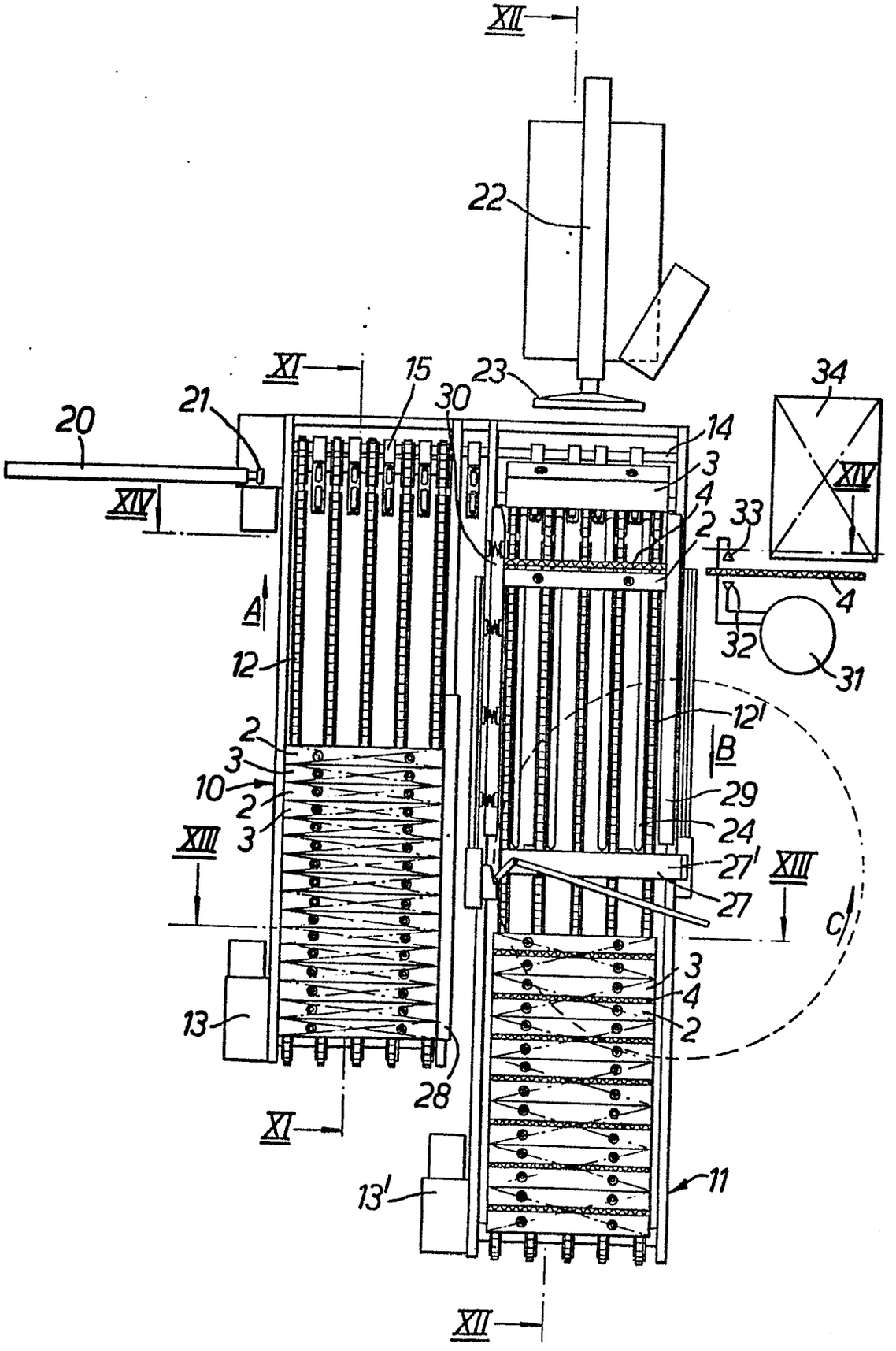
XII
22
XI
15
23
30
34
21
20
14
3
4
2
33
XIV
XIV
4
A
32
31
12
12'
2
3
B
10
2
29
3
24
XIII
27'
XIII
27
C
3
4
13
2
28
XI
13'
11
XII

FIG. 10.

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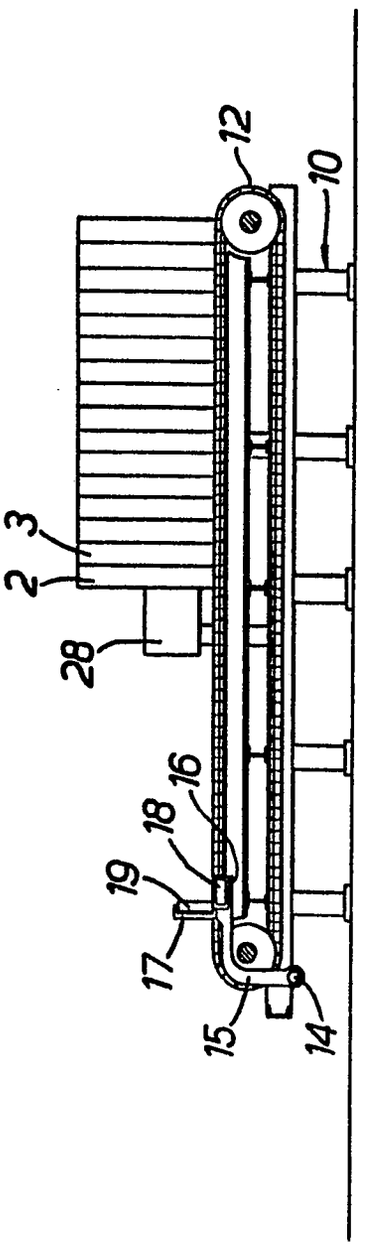


FIG. 11.

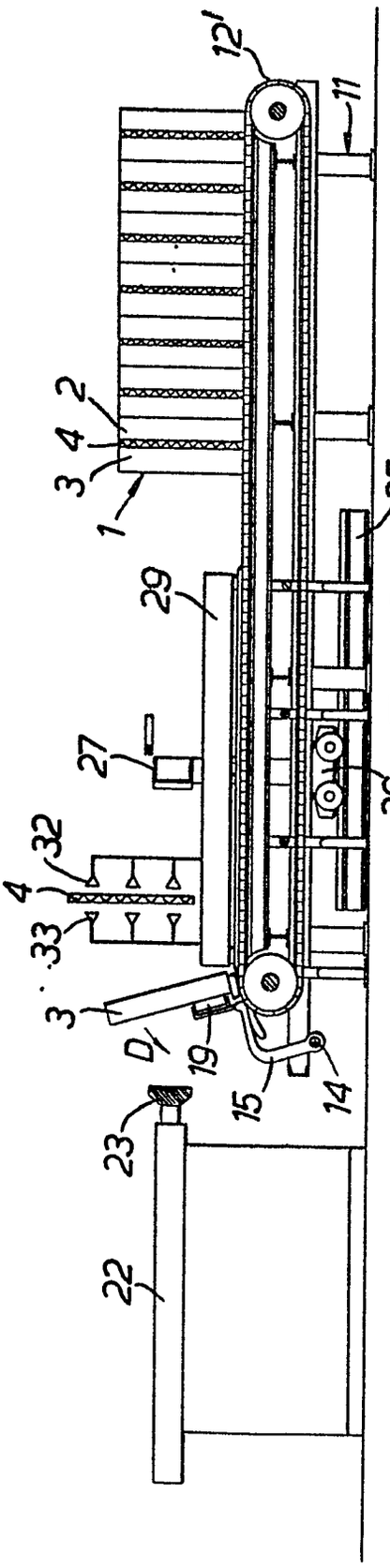


FIG. 12.

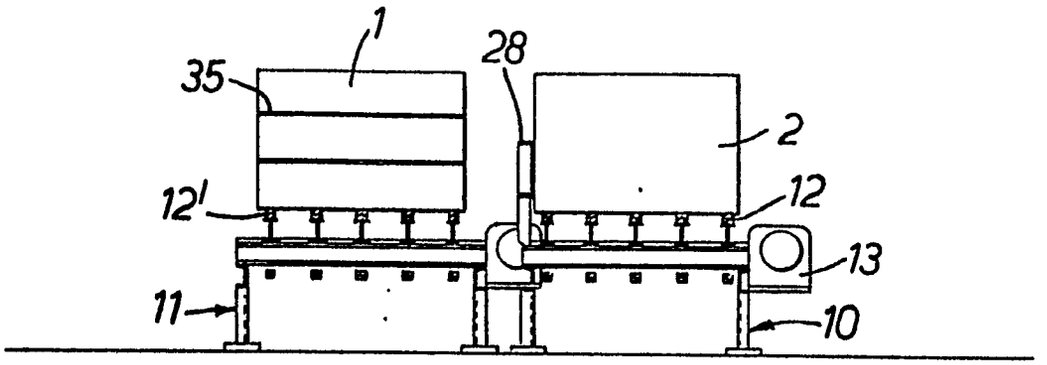


FIG. 13.

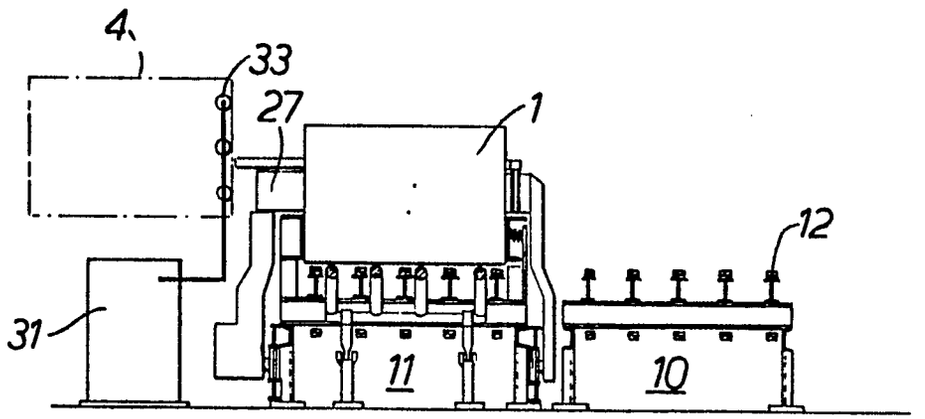


FIG. 14.