



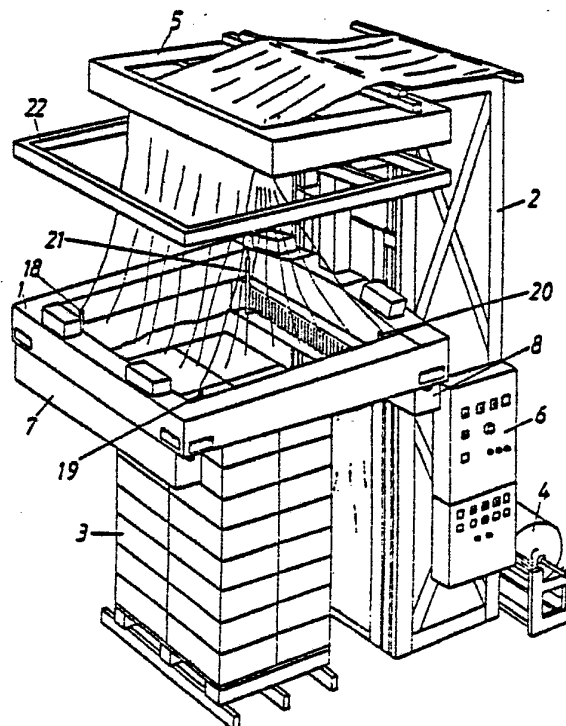
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: METHOD AND APPARATUS FOR THE PACKING OF STACKED GOODS WITH SHRINK FOIL

(57) Abstract

It is known to pack stacks with shrink foil in the form of a hood which is manually drawn down over the stack at one work station, and then which at a second work station is exposed to the influence of heat so that it shrinks around the stack. The present invention discloses a method and an apparatus whereby the covering and the shrinking are effected at one station and in a fully automatic manner, in that a foil is fed from a supply roll (4) from above and down to a shrink frame (1) which is vertically movable, and which with its downwards movement is used to draw the hood down after cutting-off and spreading, and which during its movement upwards carries out the shrinking.



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METHOD AND APPARATUS FOR THE PACKING OF STACKED
GOODS WITH SHRINK FOIL

This invention relates to a method of packing stack-
ed goods with a shrink foil which shrinks under the
5 influence of heat, by which a stack is surrounded by
the foil and thereafter heated with a shrink frame,
said frame being arranged to move up and down around
the stack.

10 With known methods of this kind, use is made of two
work places or stations, namely and firstly a sta-
tion at which the foil is fed down over the stack of
goods, and secondly a station at which the shrinking
itself takes place.

15 The object of the present invention is to rational-
ize the method to the widest possible degree, thus
enabling it to be carried out at one station and
without any significant effort on the part of the
20 operating personnel.

The method according to the invention is character-
ized by the fact that the foil is in the form of a
flexible tube, or a flexible tube provided with
25 equidistant, transverse perforations/weakenings or
transverse sealings, possibly both, which from a
supply roll is fed to the shrink frame from above,
that the free end of the tubular foil is secured to
the shrink frame, cut off or torn over to length and
30 drawn down over the stack (or vice versa) during the
downwards movement of the shrink frame, and that the
shrinking commences during the subsequent upwards
movement of the frame.



One can thus in a simple manner make use of both the upwards and the downwards movement of the shrink frame, in that the downwards movement of the shrink frame is now used for drawing down the foil, or rather the foil hood, over the stacked goods. The operator needs merely to fasten the lower edge of that foil which is to be drawn down over the stacked goods to the shrink frame, in that the frame can be provided with grippers or hook arrangements which grip the lower edge during the drawing down. At the same time that the foil is drawn down, there can also be carried out a feeding forward of that foil which is to be used in the subsequent operation. This method enables the use of several types of foil in tubular form, namely and firstly a simple tube which is pressed flat, or a tube which in its folded-together state has a double fold in each side, i.e., an inwardly-bent edge and two outwardly-turning edges in each side. In both cases it is possible to make use of a tube which is either cut off to length and welded at the top, or a tube which has already been provided with equidistant, transverse perforations/weakenings or transverse sealings.

If the foil is in the form of a tube, the method in accordance with the invention can be characterized in that a hood part is closed at the top by transverse welding together before the foil is drawn down over the stack and before being cut off.

The method according to the invention can be further characterized by the free end of the tube being secured to the edges of the shrink frame. As mentioned, this is one of the expedient embodiments for the method according to the invention, in that it must



be noted that conversely it is naturally possible to draw the foil down over the stack of goods manually without said securing.

5 One embodiment for the method according to the invention can be characterized in that when the shrinking process itself is taking place, one effects a shielding of that foil which is not yet to be shrunk. One can thus in a simple manner avoid that this foil is
10 exposed to so much upwardly-flowing heat that it is shrunk too early.

Still a further embodiment for the method is characterized in that a preliminary spreading of the tube is
15 effected by means of one or more suction blowers which are mounted on the frame, in that use is herewith made of the suction effect, while the final spreading of the foil is effected by the blowing-up of air from below by one or more of the suction blow-
20 ers. One can thus in a simple manner utilize both the suction effect and the blowing effect from the suction blowers.

Finally, the method according to the invention can be
25 characterized in that gas burners are used for the shrinking. Achieved hereby is a reduction of the risk that the foil which is situated above that foil which is to be shrunk is not exposed to heat at a time at which this is undesirable, in that contrary to other
30 means of heating gas burners can namely very quickly be shut down after the end of the operation and do not leave any residual heat.

The invention also relates to apparatus for the exe-
35 cution of the method, and which is of that type on



which is mounted a vertically movable shrink frame, said frame being substantially rectangular.

According to the invention this apparatus is characterized in that the column is connected to a supply roll of shrink foil which, in its folded-together state, has a double fold in each side, i.e., an inwardly-bent edge and two outwardly-turning edges in each side; that there are means for feeding the foil down towards the shrink frame from above; that on the shrink frame are mounted two horizontal, oppositely disposed suction boxes which are movable towards each other and away from each other for the pre-spreading of the flat tube; that at each end of the suction boxes, seen in the horizontal plane, a gripper is mounted on the suction boxes, said gripper being arranged to grip the tube at the four outwardly-turning edges during the pre-spreading of the tube, i.e., by clamping against the outer side of these edges, and that at the first-mentioned grippers for the pre-spreading are mounted another set of grippers on the suction boxes in the form of four stays, these stays being arranged to swing up into a vertical position inside the tube.

25

With such an apparatus it is possible to fully automate the method, so that the operator needs merely to activate the apparatus when the stack of goods are placed in position.

30

One embodiment of the apparatus is characterized in that the suction boxes are connected to one or more suction blowers, the pressure sides of which are connected to one or more nozzles or nozzle slots which are directed upwards in the area within and

35



below the grippers. Thus in a simple manner one can use the suction effect of the suction blowers for the pre-spreading of the foil, and then immediately afterwards use the blowing effect of the suction blowers to spread the hood part further by blowing air up into it.

A further development of this embodiment is characterized by providing each suction box with a suction blower and a horizontal nozzle slot which is disposed in the area under the suction box, and which can possibly be horizontally movable.

According to the invention the shrink frame can be of the type which is equipped with gas burners. The most possible energy is herewith saved for the shrinking, in that the gas burners do not heat the surrounding material to any noteworthy degree, and in that among others things they do not give rise to a residual heat which could contribute towards inadvertent shrinking of that foil which is pulled down from above in the middle of the area where the heating has taken place.

Another embodiment can be characterized by mounting a cutting-off mechanism and a welding mechanism above the shrink frame. It is herewith possible to cut the foil to length, so that with the same machine one can alternately effect the packing of high and low stacks of goods.

A further development of the apparatus can be characterized by the welding mechanism comprising a pair of welding jaws which are arranged to close together during the shrinking. One can thus in a simple manner

accomplish a shielding-off of that foil which is not yet to be shrunk.

A further development of this embodiment can be characterized by heat-screening plates or shields being disposed over the welding mechanism, thus making a feeding of the foil possible even during the shrinking process, so that a new length of foil is already hanging ready when the shrinking process is concluded.

Further developments of this embodiment are presented in the claims 14 and 15.

Finally, the apparatus according to the invention can be characterized by a rectangular frame which is horizontally disposed above and preferably in connection with the shrink frame, the sides of this frame being parallel with those of the shrink frame, and having plane, vertical inner surfaces, in that the frame is vertically movable. One can thus in a simple manner secure the upper part of the hood when this is blown up and is to be drawn down over the stacked goods, hereby avoiding the tearing of the hood during its downward movement over the stacked goods.

The invention will now be described in closer detail with reference to the accompanying drawings which, to a high degree, are schematized, and where

fig. 1 shows an apparatus for the execution of the method according to the invention, seen obliquely in perspective from the front,



- fig. 2 is an embodiment of the apparatus according to the invention, seen obliquely in perspective from the front,
- 5 fig. 3 shows this apparatus seen from the side,
- fig. 4 shows this apparatus seen from the side
- 10 fig. 5 shows this apparatus seen from the side, but with the movable parts in another position,
- 15 fig. 6 is a cutting-off and welding mechanism for the apparatus, shown in schematic form and partly in section,
- 20 fig. 7 seen from above and in schematic form, shows how the pre-spreading of the foil is effected by means of movable suction boxes and a set of small grippers, and
- 25 fig. 8 shows a gripper of the type shown in fig. 7, in double right-angled configuration and on a larger scale.

25 In fig. 1 there is shown an apparatus consisting of a horizontal shrink frame 1 which is vertically movable on a column 2, said frame being designed to pack a box-shaped stack 3 with shrink foil. The foil is
30 in the form of a tube and comes from a supply roll 4 at the back of the apparatus. The foil or tube is fed from here via rollers or slide rails up over the apparatus and out into a console 5 which ends above the shrink frame 1. The console 5 can have built-in
35 mechanisms for the cutting-off and the welding-together

ther of the tube, but as an alternative there can also be used a tube which has already been provided with transverse weakening slits and welded seams at suitable distances. Normally, the console 5 will also contain a pair or rollers for the feeding of the foil. The inner edges of the shrink frame 1 are equipped with heating elements. With the present invention it can be expedient for these elements to be gas burners. Furthermore, the shrink frame 1 is at its inner edges provided with grippers or hooks, whereby the lower edge of that foil which is to be drawn down over the stack 3 can be secured. Finally, the apparatus has a control panel 6 with a programme control arrangement.

15

This apparatus, which is semi-automatic, operates in the following manner:

The feeding of the foil is effected either manually by an operator or mechanically by means of the mentioned but not shown pair of rollers. The foil is then spread manually and secured to the shrink frame 1, said frame being disposed in that position shown. The cutting-off and the welding mechanism is then activated or, if the foil being used is of the type already provided with weakening slits, a hood is torn off. The operator now sets the shrink frame 1 in its downwards movement, which is expediently effected mechanically, and during this movement the foil hood is drawn down over the stack 3. When the shrink frame 1 has reached its bottom position, the foil is released from the grippers or the hooks and the shrinking commences, i.e., the shrink frame is set in its upwards movement at the same time that the heating elements are activated. When the shrink frame 1 has returned to the position shown, the op-



eration has been completed and can recommence with a new stack.

Figs. 2, 3, 4 and 5 show a further development of the apparatus shown in fig. 1. Here, the spreading and the securing of the foil is automated, i.e., the apparatus is fully automatic. Corresponding parts have the same reference numbers. In addition to the parts discussed in the foregoing, the apparatus is equipped with a pair of suction boxes 7 and 8 mounted on the bottom of the shrink frame 1, and which on rails are controlled for synchronous movement towards each other and away from each other. On the suction boxes 7 and 8 are mounted elements which lie below the suction surfaces, but which extend towards the corresponding element on the other suction box. However, these elements are offset from each other in such a way that the suction surfaces of the suction boxes can still lie almost or completely up against each other..

One or more suction blowers 9, 10 are mounted on each of the suction boxes 7 and 8, as shown in fig. 3 in association with the suction box 7. The suction side of these blowers is naturally connected to the suction boxes, while the pressure side is connected to the drawer-like elements 11 and 12 which extend under each suction box and can be pushed in under this, or be in a half-drawn-out position in a direction towards each other or in towards the middle of the shrink frame 1. This results in the provision of upwardly-inclined nozzle slots. When the drawer-like elements 11 and 12 are in the pushed-in position, which is the case when the suction boxes 7 and 8 are fed in against each other, the discharge of air from



the suction blowers is effected in another manner. It should be noted that the drawer-like elements can also be mounted on the suction boxes in a fixed way. As shown in fig. 7, on the suction boxes 7 and 8 there is also mounted a first set of small grippers 13, 14, 15 and 16. For the sake of clarity, these grippers are not shown in the foregoing drawings. These grippers have the double right-angled configuration as shown in fig. 8. Fig. 7 also shows a tube 17 of shrink foil which in its folded-together state has a double fold in each side, i.e., an inwardly-bent edge and two outwardly-turning edges in each side.

As shown in figs. 2, 4 and 5, in conclusion the suction boxes 7 and 8 have a second set of large grippers 18, 19, 20 and 21 in the form of pivotable stays capable of swinging between a horizontal and a vertical position around horizontal axes. In fig. 4 the stays 19 and 20 are in the horizontal position, in that the stays run at right angles to the plane of the paper.

Finally, above and in connection with the shrink frame 1 is mounted a second horizontal frame 22 supported underneath by a column 23. The column 23 can have a built-in telescopic part, thus enabling the distance of the frame 22 from the shrink frame 1 to be varied.

Fig. 6 shows a cutting-off and welding mechanism which is built into the outer end of the console 5. A pair of rollers 24 and 25 feed the foil 26 to a slot between two pairs of holding jaws 27, 28, 29 and 30, of which the last-mentioned and lower pair

also serve as welding jaws. A knife 31 is fastened to an endless chain 32, 33 and is driven forwards and backwards by a not-shown motor in the suggested supports. The knife can also be driven in the same direction the whole way around.

The apparatus in accordance with figs. 2 - 8 functions in the following manner:

At the start of an operation, the shrink frame will be in its upper position, e.g., the position shown in the drawings. The feeding of the foil now takes place by means of the pair of rollers 24 and 25 until the lower edge of the foil is level with the lower edges of the suction boxes 7 and 8. Like the jaws 27, 28, and 29, 30, the suction boxes 7 and 8 are, of course, moved into a position away from each other, so that the foil can pass freely. The length of the foil hanging downwards is naturally adjusted in accordance with the height of the stack to be packed. This length can be measured off by means of the programme control arrangement, but it can also be effected automatically with sensors already known within the art.

When the feeding of the foil is brought to an end, the suction boxes 7 and 8 are fed in towards each other so that they surround the lower edge of the foil. The suction blowers 9, 10 and others are then started, and the suction boxes 7 and 8 are withdrawn a small distance away from each other and stopped. This position is shown in figs. 4 and 7. In this position, the small grippers 13, 14, 15 and 16 are activated and swing in the direction of the arrows as shown in fig. 7, whereby they secure the four outwardly extending edges of the foil cross section ex-



ternally. The suction boxes 7 and 8 are then made to continue their movement until the foil cross section is opened so much that the second set of grippers 18, 19, 20 and 21 can safely swing up inside the foil.

5 This happens at the same time that the first set of small grippers 13, 14, 15 and 16 swing back into the start position as shown in fig. 7. It should be mentioned here that the second set of grippers 18, 19, 20 and 21 are disposed a good distance from the suction surfaces to ensure a correct upswing, and that

10 this distance takes on significance in the following step, during which the suction boxes move further away from each other and thus through the grippers 18, 19, 20 and 21 tighten the lower part of the foil cross section to form a rectangle. This results in

15 the foil being drawn free of the suction surfaces, thus allowing air to flow in. The effect is that the suction blowers now come to supply air out of the upwardly-inclined nozzle slots at the drawer-like

20 elements 11 and 12, which are in the position as shown in fig. 4. A stream of air is thus blown up into the foil from two sides, and the foil can now be released by the jaws 29 and 30 at the top, after the knife in the meantime has been activated. The

25 suction boxes 7 and 8 end in the position shown in fig. 5, where the frame 22 is of significance, in that the size of the frame 22 is of such dimensions that it can prevent the upper part of the now formed foil hood from swinging from side to side or flap-

30 ping as a result of turbulence in the air. As mentioned, the frame 22 can be adjustable in height if stacks of varying heights are being worked with. Hereafter, the foil hood can be drawn down over the stack 3 without being damaged by the upper corners

35 or edges of the stack. This is carried out by feed-

ing the frames and the parts mounted thereon down
the column 2. When the shrink frame has reached its
bottom position, the suction boxes are moved so much
in towards each other that the grippers 18, 19, 20
5 and 21 relieve the foil to such an extent that the
grippers can swing down into the horizontal position
free of the foil, after which the shrinking can be-
gin during the upwards movement of the shrink frame.
Prior to this, however, the jaws 27,28 and 29,30 can
10 have been moved towards each other into the closed
position, thus shielding-off the foil which must not
be shrunk prematurely. In this connection it can
also be envisioned that regular heat-shielding plates
or screens can be mounted, thus allowing the foil to
15 be fed while the shrinking is being carried out, so
that a length of foil is hanging ready under the jaws
27, 28 and 29, 30 when the shrink frame has reached
its upper position and is ready for a new operation,
whereby time can be saved. Consideration can also be
20 given to cooling that space or those spaces through
which the foil is fed by means of a cooling fan.

Taken as a whole, it can be foreseen that especially
the programme for the operation of an apparatus ac-
25 cording to the invention will be variable within a
wide range. It must thus be noted that it is not nec-
essary to move the suction boxes towards each other
at the end of the process in order to release the
grippers 18, 19, 20 and 21 from the foil. One can
30 thus, and as a matter of course, turn the grippers
directly free of the foil to the horizontal position.

C L A I M S

1. Method of packing stacked goods with a shrink foil which shrinks under the influence of heat, whereby a stack (3) is surrounded by the foil and thereafter heated with a shrink frame (1), said frame
5 being arranged to move up and down around the stack (3), c h a r a c t e r i z e d in that the foil is in the form of a tube, or a tube provided with equidistant, transverse perforations/weakenings or transverse seals, possibly both, which from a supply
10 roll (4) is fed to the shrink frame (1) from above; that the free end of the tube is secured to the shrink frame (1), cut off or torn over to length and drawn over the stack (3) (or vice versa) during the downwards movement of the shrink frame (1), and that
15 the shrinking is commenced during the subsequent upwards movement of the frame (1).
2. Method according to claim 1, and wherein the foil is in the form of a tube, c h a r a c t e r -
20 i z e d in that the foil, before being drawn down over the stack and before being cut off, is welded together transversely, i. e., a hood part is closed at the top.
- 25 3. Method according to claims 1 or 2, c h a r a c t e r i z e d by the free end of the tube being secured at the edges of the shrink frame (1).
- 30 4. Method according to claims 1, 2 or 3, c h a r a c t e r i z e d in that one effects a shielding of that foil which is not yet to be shrunk, while the shrinking process itself takes place.



5. Method according to claims 1, 2, 3 or 4, characterized by the carrying out of a preliminary spreading of the tube by means of one or more suction blowers which are mounted on the frame, in that use is made herewith of the suction effect, while the final spreading of the foil is effected by the blowing of air upwards from below by one or more of the suction blowers, in that use is thus made here of the blowing effect.
6. Method according to one or more of the claims 1 - 5, characterized by the use of gas burners for the shrinking.
7. Apparatus for the execution of the method in accordance with one or more of the claims 1 - 6, and with a column (2) on which there is mounted a vertically movable shrink frame (1) which is substantially rectangular, characterized by the column (2) being connected to a supply roll (4) of tubular shrink foil which, in its folded-together state, has a double fold in each side, i.e., an inwardly-bent edge and two outwardly-turning edges in each side; that there are means for feeding the foil down towards the shrink frame from above; that on the shrink frame (1) are mounted two oppositely disposed, horizontal suction boxes (7, 8) which are movable towards each other and away from each other for the preliminary spreading of the flat tube; that at each end of the suction boxes (7, 8), seen in the horizontal plane, a gripper (13, 14, 15, 16) is mounted on the suction boxes, said grippers being arranged to secure the tube at the four outwardly-turning edges during the preliminary spreading, i.e., by clamping against the outer side of these edges, and

that at the first-mentioned grippers (13, 14, 15, 16) for preliminary spreading are mounted a second set of grippers (18, 19, 20, 21) on the suction boxes (7, 8), said second set of grippers being arranged to swing
5 upwards into a vertical position inside the tube.

8. Apparatus according to claim 7, characterized by the suction boxes (7, 8) being connected to one or more suction blowers (9, 10), the
10 pressure sides of which are connected to one or more nozzles or nozzle slots (11, 12) which are directed upwards in the area within and below the grippers (18, 19, 20, 21).

15 9. Apparatus according to claim 8, characterized in that for each suction box (7, 8) there is an associated suction blower and a horizontal nozzle slot (11, 12) disposed under the suction box, and which can possibly be movable horizontally.

20

10. Apparatus according to claims 7, 8 or 9, characterized by the shrink frame (1) being of the type equipped with gas burners.

25 11. Apparatus according to claims 7, 8, 9 or 10 for the execution of the method according to claim 2 and possibly the claims 3, 4, 5 or 6, characterized by a cutting-off mechanism (31) and a welding mechanism (29, 30) being mounted above
30 the shrink frame (1).

12. Apparatus according to claim 11, characterized by the welding mechanism (29, 30) comprising a pair of welding jaws which are arranged to
35 close together during the shrinking.

13. Apparatus according to claims 11 or 12, c h a r-
a c t e r i z e d by heat-shielding plates or
screens which are placed over the welding mechanism
(29, 30).

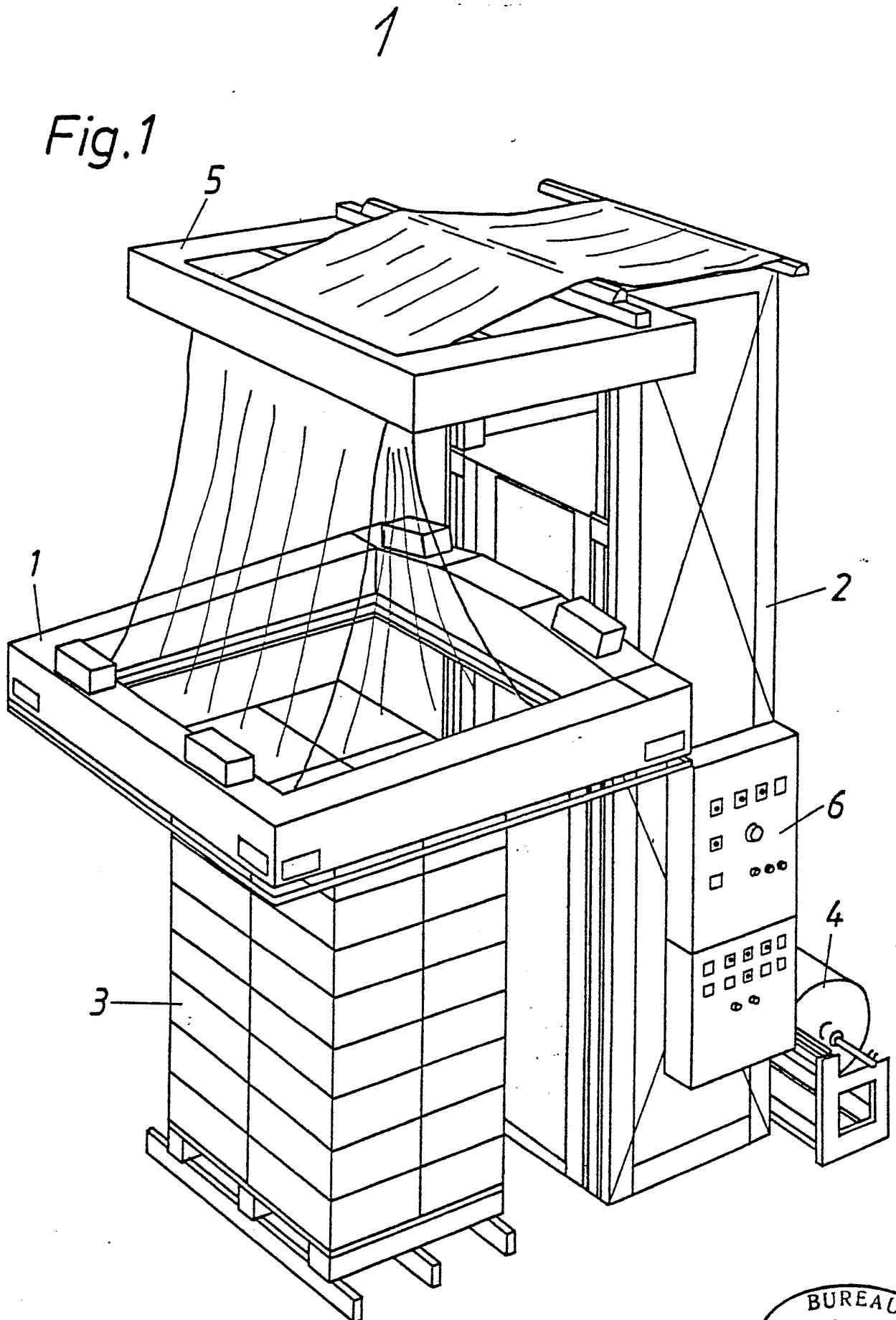
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14. Apparatus according to one or more of the claims
11, 12 or 13, c h a r a c t e r i z e d by heat
-shielding plates or screens which are placed under
the welding mechanism (29, 30) and extend some dis-
10 tance downwards from said mechanism, and possibly
forming a completely or partly closed box.

15. Apparatus according to claims 13 or 14, c h a r-
a c t e r i z e d by one or more cooling fans which
15 are arranged to blow air in between the plates or the
screens.

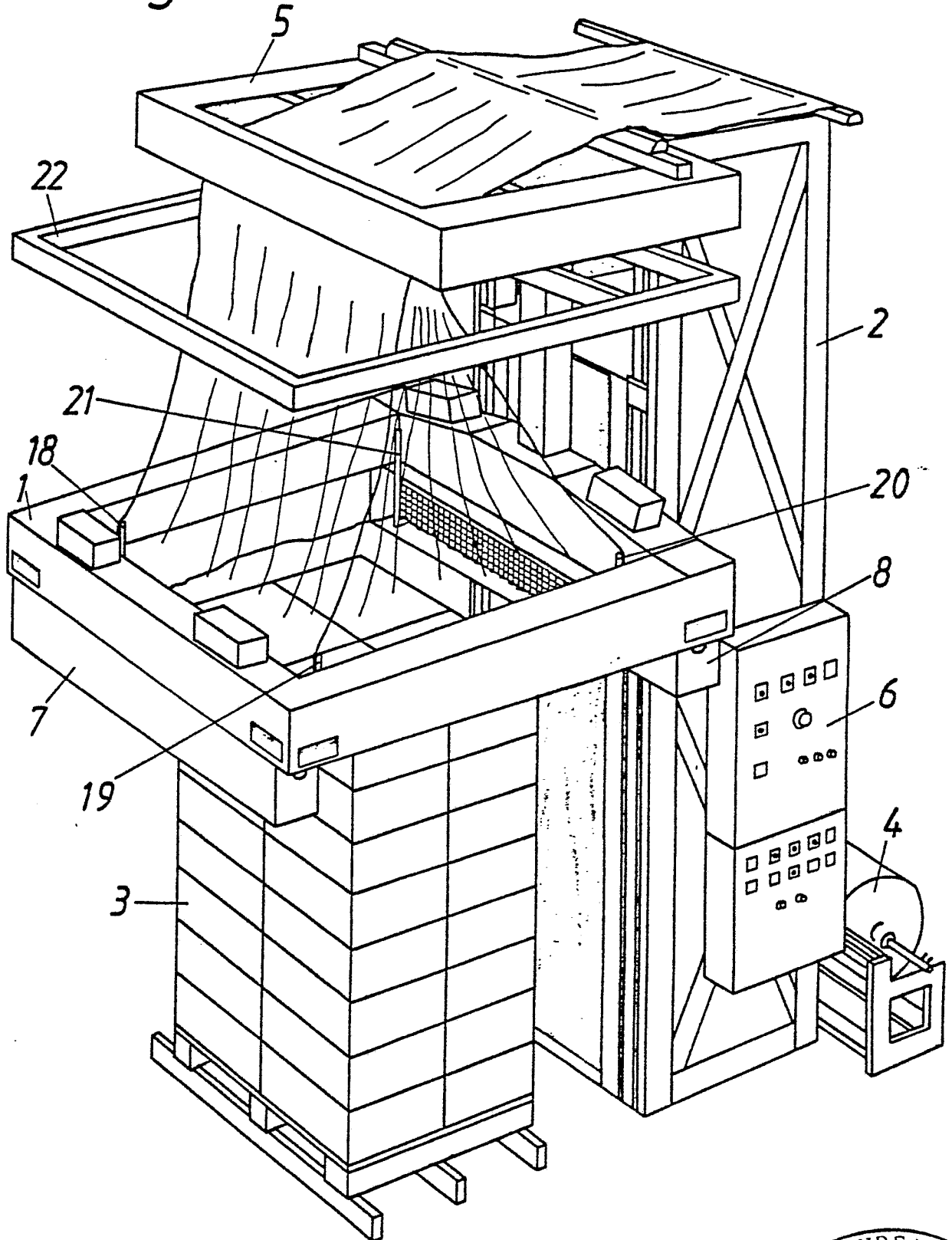
16. Apparatus according to one or more of the claims
7 - 15, c h a r a c t e r i z e d in that above the
20 shrink frame (1) and preferably in connection with
same there is mounted a rectangular, horizontally
disposed frame (22), the sides of which are parallel
with those of the shrink frame (1), and displaying
plane, vertical inner surfaces, in that the frame is
25 vertically movable.

Fig.1



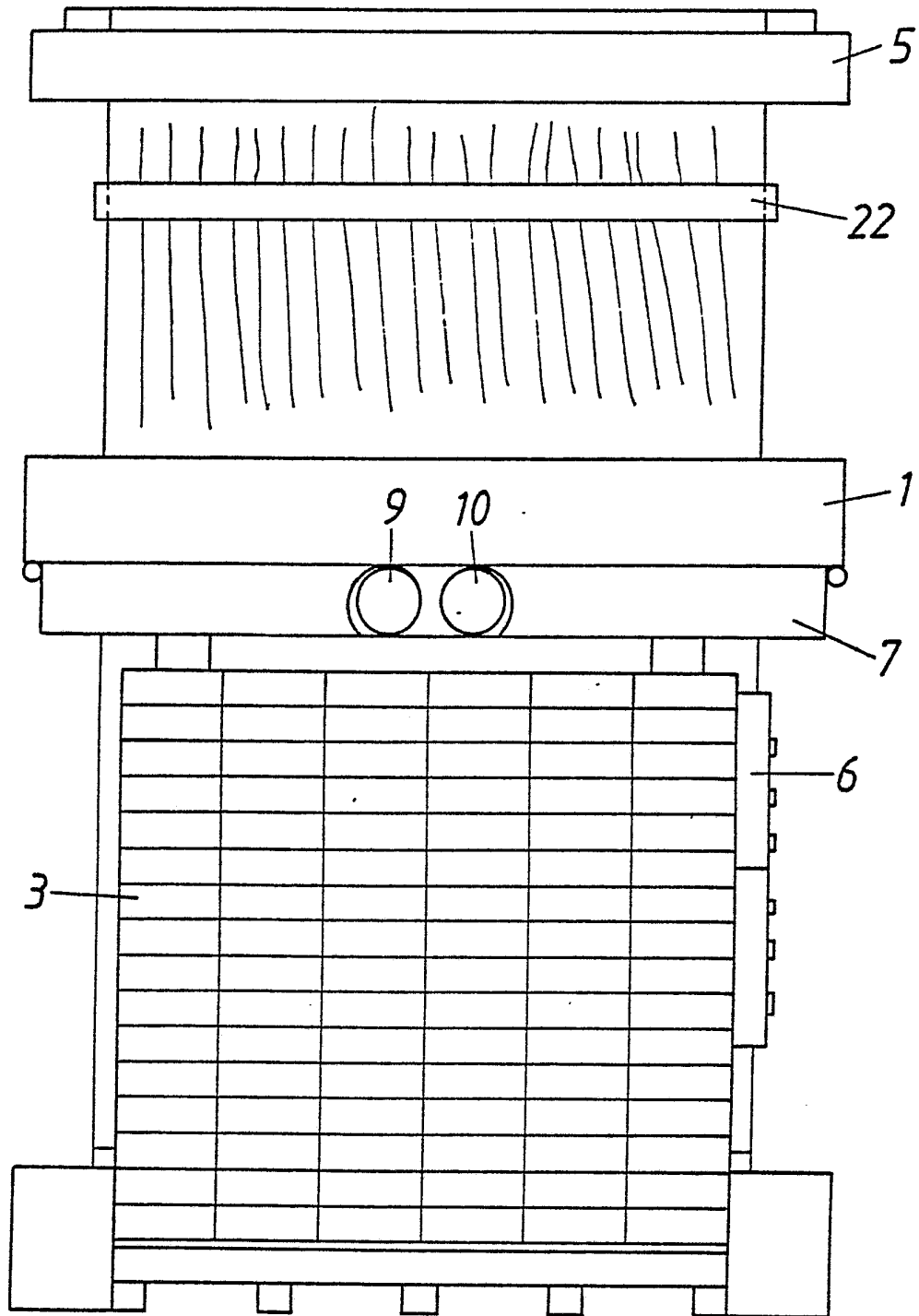
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Fig. 2



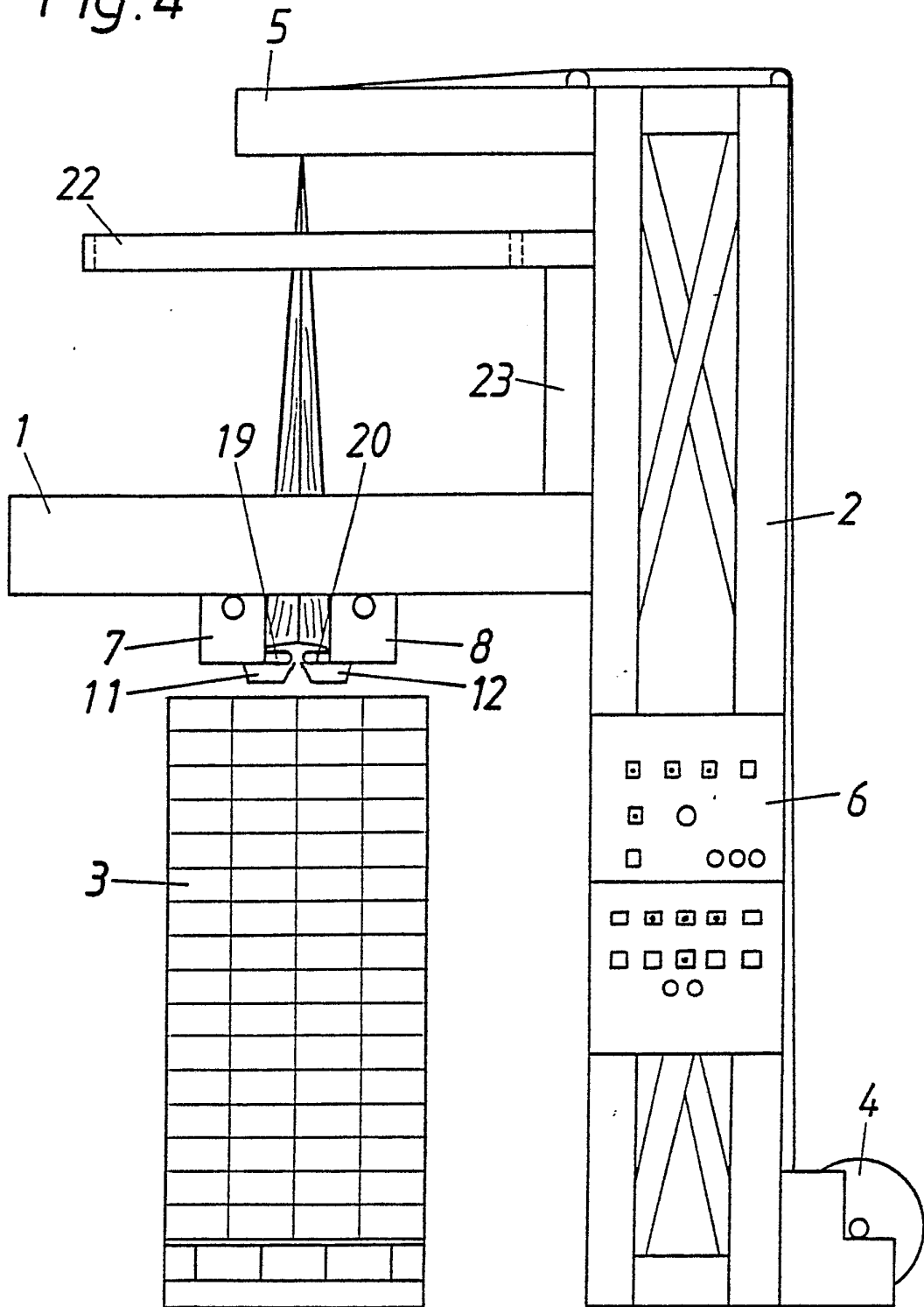
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Fig.3



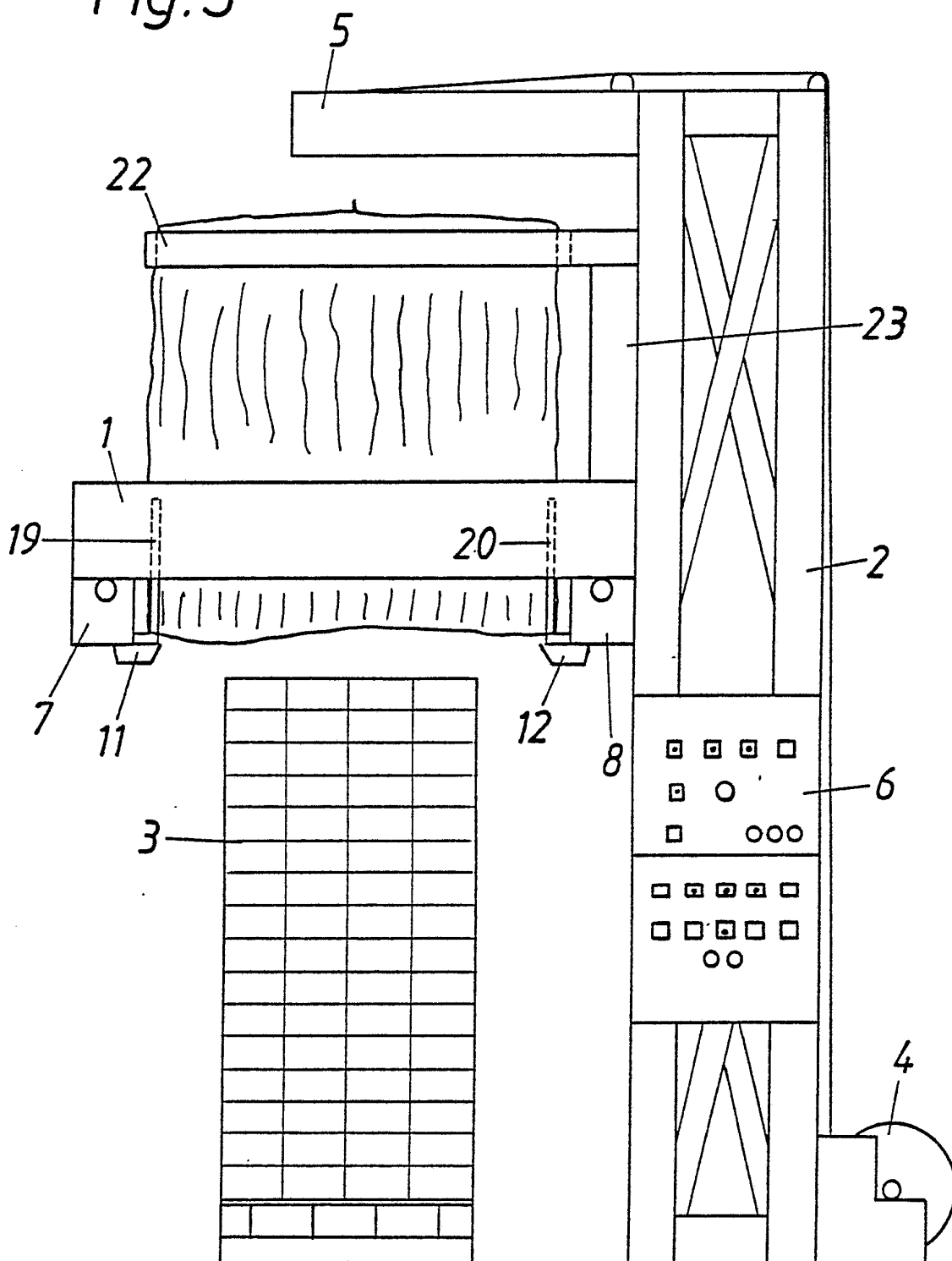
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Fig. 4



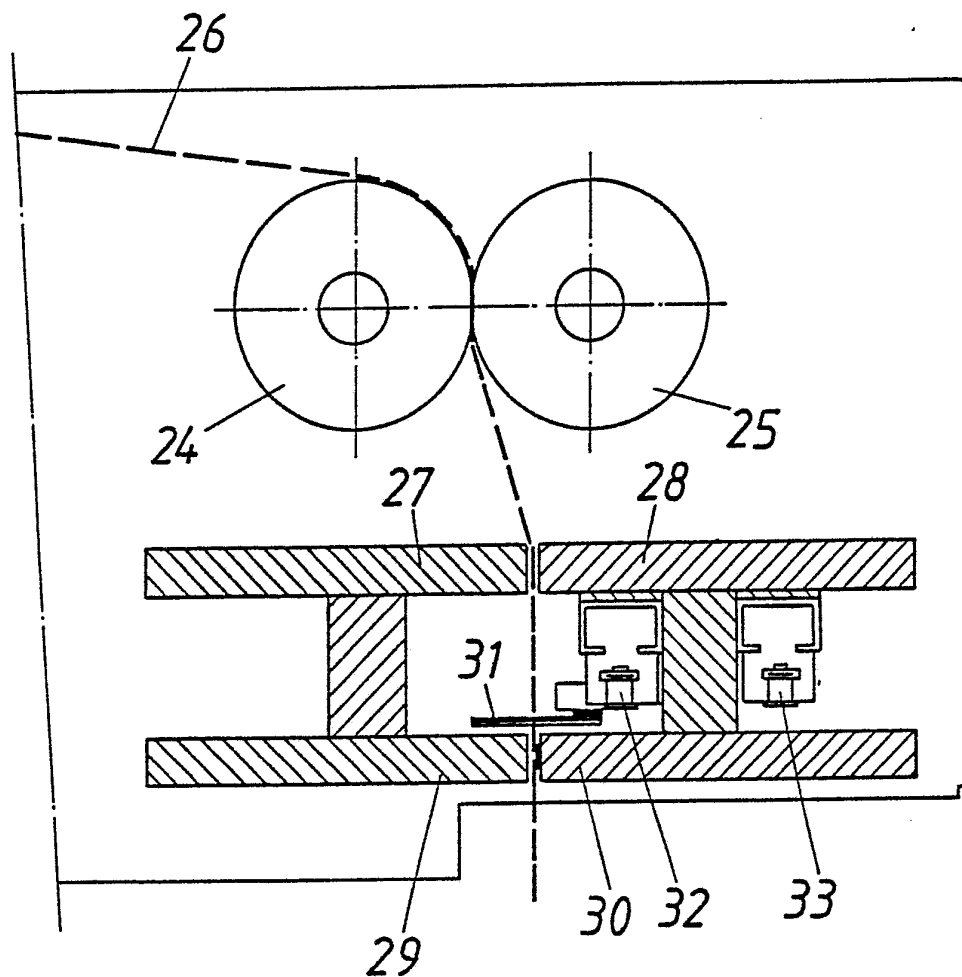
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Fig. 5



6

Fig.6



7

Fig. 7

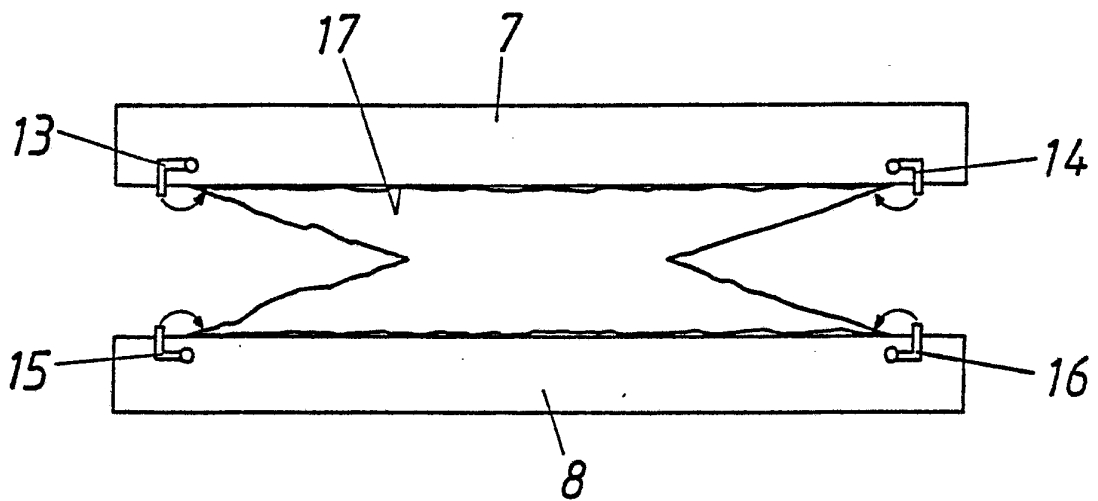
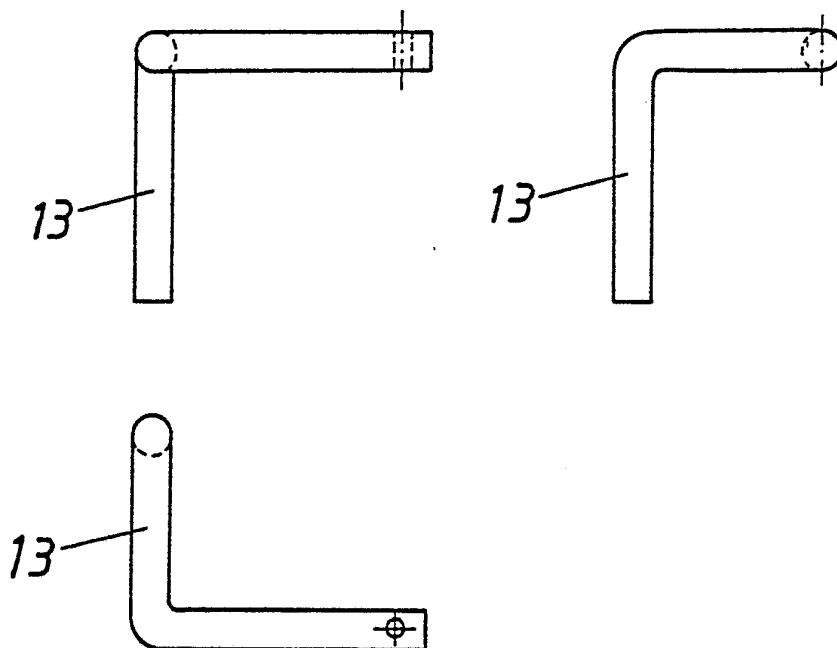
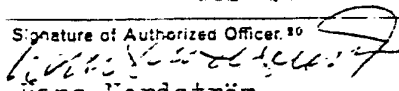


Fig. 8



INTERNATIONAL SEARCH REPORT

International Application No PCT/DK82/00038

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC 3		
B 65 B 9/14, 43/26, 53/06		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC 3	B 65 B 9/00, /10, /13, /14, 41/12, /14, 43/26, /34, 53/02, /06 B 65 D 75/28, /38	
National Cl	81a:1, 2/01, 3/01, 5/01, 6/01, 7/01, 7/10, 7/20, 8 .../...	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁵
Y	SE, B, 335 498 (O E GUSTAVSSON) 8 August 1969	1,7
Y	US, A, 4 050 219 (HIGGINS) 27 September 1977	1,7
X	US, A, 4 050 219 (HIGGINS) 27 September 1977	2,11
A	US, A, 4 050 219 (HIGGINS) 27 September 1977	3-5,8,9
<p>⁶ Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Δ" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ¹⁸		Date of Mailing of this International Search Report ¹⁹
1982-06-30		1982-07-07
International Searching Authority ¹		Signature of Authorized Officer ²⁰
Swedish Patent Office		 Hans Nordström

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields Searched (cont)US Cl 53:28-30, 177, 183-184, 441-442, 556-557V. **OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰**

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:2. Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:VI. **OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹**

This International Searching Authority found multiple inventions in this international application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:4. As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

 The additional search fees were accompanied by applicant's protest. No protest accompanied the payment of additional search fees.