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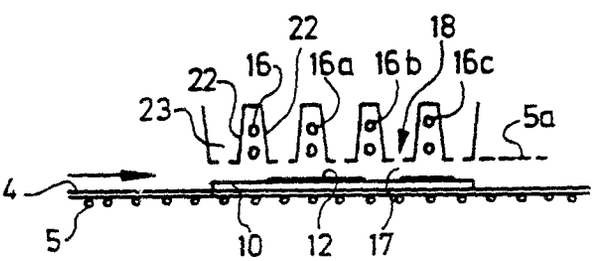
(54) Drying installation.

(57) Drying installation intended mainly for the drying of printing ink (12) applied to a material (10) from a printing machine, including a transport arrangement (4) or path forming a carrier for a material (10) through the drying installation together with a number of heatradiating members (16-16c) intended for drying and/or curing of printing ink applied to the material, together with a number of holes (18) or nozzles intended to permit the passage of an air flow. The respective heat-radiating members (16) are designed to firstly supply heat to the members (22) for heating up an air flow (23) which is intended to pass through the holes or nozzles (18) and be directed by these towards the transport arrangement (4) and secondly to supply heat by radiation to printing ink (12) which has been applied to the material (10).



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TITLE OF INVENTION: Drying Installation

Technical Field

The present invention relates to a drying installation and preferably to a drying installation which is designed to dry printing ink applied to a material from a printing machine. The drying installation includes a transport arrangement, comprising a carrier for the material through the drying installation, together with a number of heat-producing members which are intended to dry and/or cure the printing ink applied to the material, and a number of holes or nozzles provided for the passage of air.

The invention aims at providing information concerning a drying installation which cannot merely dry the printing ink which is curable by means of infra-red rays or ir-rays, but which can also dry the printing ink which is solvent-based and where drying occurs principally via hot air.

Firstly it should be noted that the invention is not dependent on the printing machine employed, but on the other hand it should be borne in mind that the present invention can be utilised with advantage when the printing machine comprises a stencil printing machine and where the applied layer of printing ink is thick.

BACKGROUND

The method is already known of arranging various types of drying installations adjacent to printing machines so that by this means it is possible to dry the

printing ink applied to a material from the printing machine.

The drying process and the drying methods which can be employed are governed by the chemical composition of the ink and the printed material.

Thus the method is already known of bringing about catalyst curing or polymerisation when the printing ink has profit as such that it can cure with the aid of members which emit ultraviolet rays. Here curing of the printing ink takes place with the aid of "radiation curing" and this signifies that the radiation activates a catalyst in the printing ink and polymerisation of the ink layer (interlinking of molecules) takes place.

Furthermore, with solvent-based printing inks, the method is already known of undertaking the drying process by evaporation or vaporisation, ie physical drying, and for this purpose it has been proposed that hot air should pass across the material on the side where the printing ink has been applied.

It is also known that physical drying, which takes place as result of evaporation or vaporisation of a solvent-forming part of a printing ink, can result in reducing drying time as a funciton of an increasing quantity of air (injection) and/or an increasing supply of heat.

Furthermore, the use of heat-producing members, for speeding up the drying process, is already known utilising mainly the infra-red radiation (ir-radiation)

emitted from the member.

The stencil printing inks which are normally employed dry as result of evaporation or by curing, or by means of a combination of these two methods, and since the drying installation has to be designed so that it can cope with all printing inks it is obvious that its design becomes complicated.

DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

Regardless of the type of ink employed or the drying installation utilised it is common to all drying installations that these are regarded as a necessary evil, because a large proportion of the production costs are incurred in the high energy consumption and high power requirements of the drying installation.

Generally it also applies, obviously, that energy consumption and power requirements depend on the material used, the ink applied, the thickness of the ink and the speed of the material through the drying installation.

For this reason the fact has emerged that power requirements become extremely high if the drying installation is to be dimensioned so that it will dry printed matter from a stencil printing machine operating at high speed and with thick ink layers.

One particular problem has emerged when the aim has been, by increasing the quantity of air per unit of time,(injection), to reduce the drying time because

the heat-emitting members are normally placed in the air flow adjacent to the nozzles and consequently these members represent an obstacle to the air flow and change the flow pattern.

It is obvious that the energy fed into a drying installation should be capable of being adapted to the circumstances prevailing at the time. Consequently it should be possible to shut down a drying installation when no material is to be dried; it should be possible for the power input to increase when material is passing through the drying installation, and match this to the sheet material involved, the printing ink and its thickness, also the speed of the material.

This signifies that it should be possible to start up the drying installation rapidly to achieve full speed and to deal with thick layers of printing ink.

In this connection it has proved to be an extremely difficult technical problem when using a high power input to rapidly create the requisite conditions for heating up and drying printing inks, even when the air channels exhibit a considerably reduced temperature.

In order to achieve the desired rapid heating up it is certainly vital that all the energy input be employed for the actual drying process and that as little as possible is lost, but even more important is the fact that energy distribution should be controlled so that the material is not damaged by heat.

It has also proved to be a problem when drying a layer of ink on the material, where low drying temperatures are required, to ensure effective drying without overheating. Particularly under such circumstances no direct heat radiation is required, it being sufficient here to have a heated flow of air.

When drying at high temperature, it is not sufficient to have a high temperature in the air flow, effective direct heat radiation being required, preferably infra-red radiation.

Particularly at high printing speeds it has proved to be a problem to restrict heat transfer from heat-emitting members to the material. As a rule direct and/or indirect heat treatment throughout the entire drying installation results in an excessively high temperature on the part of the material.

With high power input it is also a difficult technical problem to attain thorough drying of the printing ink on the material with relatively low heat transfer to the material, because these measures will normally either dry the outer layer of ink, or else the material becomes hot.

It is obviously an even more difficult problem to make heat application so intensive and so rapid that for thorough drying of printing inks only a portion (the first portion) of the entire drying installation is switched on.

THE SOLUTION

The present invention relates to a drying

installation which is preferably designed to be able to dry printing ink applied to a material from a printing machine and where the drying installation includes a transport arrangement, comprising a carrier of a material through the drying installation, together with a number of heat-producing members which are designed to dry and/or cure the printing ink applied to the material, together with a number of holes or nozzles suitable for passage of air.

With the aim of solving the problems described above the present invention indicates that the respective heat-producing members should be arranged so that on the one hand they supply heat to members for heating up the hot air which is arranged to pass through holes or nozzles and by this means be directed towards the transport arrangement, and secondly to supply heat by radiation directed towards the transport arrangement and the printed material resting thereon.

The member should preferably be wave-shaped with downward facing portions provided with holes or nozzles and with upward facing portions and adjacent wall portions forming a space containing one or more heat-radiating members, the said space being opened at the bottom facing the transport arrangement. Means which are designed to give off heat from metal to air are provided against the downward facing portions and the adjacent wall portions. The member should preferably be provided with flush downward facing and upward facing portions and flush wall portions.

The invention relates to a drying installation where the heat-radiating member comprises one or more members emitting infra-red rays and possibly a reflector.

The invention furthermore indicates that an air flow be arranged on each side of the member so as to reduce the temperature rise of the printing ink.

Because the flow of air "cools" the upper surface of the printing ink, a high power input can be connected up to the member with resultant efficient drying of the layer of ink without a significant amount of heat being transferred to the material.

TECHNICAL ADVANTAGES

The technical advantages which can be perceived as being connected with a drying installation in accordance with the present invention are that heating up of the air employed can take place very rapidly because full power input connected up to the heat radiation members will immediately produce high heat radiation and contribute towards heating up the hot air, because if the heat-radiating members are switched in for a longer period this signifies that heat is transmitted to the member for heating up the hot air and subsequently the power input can be reduced, because the air heated up in this way takes over the task of drying from the heat emitters.

When drying a layer of ink on a material suited for low temperature, in accordance with the invention arrangement, simple regulation of temperature can take place.

In addition the combination of efficient infra-red-emitting members with the air flow against the printing ink ensures that heat transmission to the material is low, but effective drying of the printing ink does take place.

The essential characteristics of a drying installation in accordance with the present invention are described in patent claim 1 which follows.

BRIEF DESCRIPTION OF DRYINGS

In the following details are given, by reference to appended drawings, of an embodiment of the present invention which exhibits the most significant features.

Fig. 1 illustrates a proposed drying installation in perspective view utilising the characteristics which are significant of the present invention.

Fig. 2 illustrates in side view and section a portion of the drying installation where the present inventive arrangement can be employed,

Fig. 3 shows the temperature variations in the material as this passes through the drying installation and

Fig. 4 shows in perspective view a preferred embodiment of the orientation of the heat-radiating members.

BEST MODE OF CARRYING OUT THE INVENTION

Thus Fig. 1 shows in perspective view a drying

installation designed for a printing machine, particularly a stencil printing machine, resting on a sub-surface 1. The actual drying installation has been given the reference notation number 2. The drying installation consists of a pedestal 3 supporting a transport arrangement in the form of a transport path which can move in the horizontal plane. This transport path 4 is intended to transport from position "A" sheets provided with printed matter and printing ink or material originating from a printing machine to a position "B" located on a stacking arrangement which is not shown. The sheet or material provided with print are intended to pass through the drying installation 2 so as to dry the printing ink which forms the printed image. For this purpose drying installation 2 has a number of members, not illustrated in Fig. 1, to produce heated air and for connecting power input to the heat radiators or to the members emitting infra-red rays. These members are incorporated in the upper portion of the drying installation with reference notation 3b whilst the control equipment for the members is located in the lower portion of the drying installation with reference notation 3a. The heated air passes around the installation through channels, not shown, to an upper portion 3b and in this portion 3b the air is allowed to pass through a number of nozzles orientated in a plane above the horizontal plane of the transport path.

As the printed sheet or material is fed from the printing machine at a predetermined height it is essential that the portion of the transport path 4 provided

with reference notation 4b be located at a height which permits it to receive the sheet or material provided with print from the printing machine. Hence section 4b has to be fixed. The same can be regarded as applying to section 4c, which is a discharge section of the transport path 4. It should be noted that in Fig. 1 the transport path 4 is placed at a distance "a" from section 3b and particularly a plane 5a defined by the nozzles in section 3b. This spacing "a" must be sufficient to enable the printed material to pass into the drying installation even if the material exhibits considerable height.

Finally Fig. 1 shows that section 3b is arranged, via a hinge 8 to be capable of being bent upwards to the position shown by dashed lines for inspection firstly of the transport path, and secondly of the nozzles located on the inside of section 3b, and for cleaning of the reflectors and replacement of the heat-radiating members.

By means of an arm 6 it is possible to regulate the spacing "a", in that the arm 6 rotates around a centre of rotation 20 and by this means raises or lowers the transport path 4 in the drying section.

A control panel is indicated by reference notation 7.

Fig. 2 illustrates in height view and section a portion of a drying installation in which the principle of the invention can be utilised. Here the material has been given reference notation 10 and the printing ink

applied by the printing machine is given reference notation 12. The drying installation 3 comprises a transport arrangement 4 in the form of a net-shaped path resting on a number of rollers 5 and the transport path 4 with rollers 5 thus provides a carrier for the material 10 when this passes through the drying installation. Furthermore the embodiment has at least two, in the example illustrated four, members 16,16a,16b,16c which emit infra-red rays intended to dry and/or cure the printing ink, but naturally the number does not impose any limitation on the function of the invention.

Each of the members 16,16a,16b and 16c which emit infra-red rays are located at such a distance from each other that a nozzle for hot air can be orientated between the respective members 16,16a etc. The material and the printing ink can then be exposed firstly to infra-red rays via the member 16 for curing the printing ink 12, and secondly to an air flow via the hot or cold air flow derived from the nozzles 18.

It is however important that a section 17 between member 16b and 16c be designed so that it is possible there to process the material and printing ink with air, for example cooled or heated air. It is also suggested that the air should be capable of passing through special nozzles 18 so as to distribute the flow of air above the surface of the material 10.

Fig. 3 illustrates a temperature curve for the upper surface of the layer of ink 12 applied to the material 10 when this passes through the drying installation

shown in Fig. 1. If there is no air flow through the nozzles 18, there is a temperature rise as shown by the curve "t_1" because of the heat, preferably infra-red heat, generated by the members 16 - 16c which emit the infra-red rays. If a flow of air traverses the nozzles 18, then the upper surface of the material 10 will in section 17 be influenced by the air flows from both the nozzles adjacent to a member 16 and in such case there will be a slightly moderated temperature rise in the upper surface of the material as shown by curve "t_2". Naturally the temperature curve can be reduced further if a flow of cold air is employed.

It is of particular interest to note that curves "t_1" and "t_2" apply to the temperature in the upper surface of the material 10. Concerning the temperature of the material 10, this exhibits essentially the same temperature because the air flow ensures that heat transfer does not take place to the material 10.

The present invention is intended particularly to comply with the requirement that the necessary heat transfer be obtained rapidly from the heat-producing and radiating members to the layer of ink 12 which has been applied to the material 10, by this means ensuring rapid drying.

This is obtained by connecting full power input to the members 16,16a,16b and 16c which emit the infra-red rays.

Of particular importance, as shown in Fig. 4, is the effect of each of the heat-radiating members 16,

because full power input to each of the heat-radiating members 16 - 16c signifies that these rapidly adopt such a high temperature that the members glow intensely and by this means mainly high infra-red heat radiation takes place direct to the ink-coated section 12a of the material 10 which is positioned below the member. Here this involves exclusively direct radiation of heat towards the material 10. However, connection of full power input to the heat-radiating member 16 also results in heat being transmitted to the member 22 for heating up a flow of air 23 which is intended to pass through the holes or nozzles 18, 18' and as a result hot air is directed against the transport path 4 and the material 10 in section 12b.

It should be noted that when first switched in a heat-radiating member 16 which glows red transmits initially radiant heat to the material 10 and that some time is required until the member 22 is heated up and a further period before the air flow 23 has been heated up.

When however the air flow 23 has been heated up to the required level, the power input to the heat radiating member 16 can be reduced so that the total effect of heat transfer for sections 12a and 12b is essentially the same, regardless of whether heat transfer is measured directly after the heat-radiating member 16 is switched in or if it is measured after a steady-state condition exists between the hot air and heat radiation.

The invention now refers to an embodiment where the member 22 is to be wave-shaped and with downward facing portions 22a provided with holes or nozzles 18, 18'. The member 22 is also provided with upfacing portions 22b and with adjacent wall sections 22c and 22d forming a space 24 which encloses the heat-radiating member 16. The space 24 is open at the bottom facing the transport path 4 so that by this means radiant heat can be transmitted from the member 16 direct to the material 10.

It is also proposed that means, which are not shown in Fig. 4, designed to emit heat from metal to air be provided adjacent to the downward facing portions of the wall portions 22c and 22d. These means can be guide rails or the like. The member 22 is provided with plane downward facing portions 22a and plane upward facing portions 22b together with plane wall portions 22c and 22d.

The number of heat-radiating members 16, possibly members 21 emitting ultraviolet rays, and the question as to whether one or more members are to be allocated to each space 24, alternate spaces, or some other distribution, depends on the sphere of application.

As shown in Fig. 4, the present invention also relates to a drying installation of the type described above where a supplementary heat-radiating member comprises a member 21 which emits ultraviolet rays, with a reflector 25. This is so designed that it can reflect the flow of light also directed away from the transport

path 4 towards the transport path4, ie the flow of light which is directed upwards in Fig. 4. For this purpose the upper portion of the reflector should be provided with an angle-shaped portion 26, the tip of which is orientated towards the member 21 which emits ultraviolet rays and at the side which faces away from the transport path 4. This design ensures that upwardly directed ultraviolet rays are reflected towards the material 4 at the side of the actual member 21.

Of particular technical significance is the fact that there are flows of air on either side of the member through the nozzles 18, 18' which are directed towards and distributed around the material 10 and the printing ink 12. By this means it is possible to have extremely high connected power inputs to the member 16 without there being a risk of heat transfer to the material 10 and without the heat "persisting" within the printing ink 12a.

As a result the drying time is short and the temperature rise of the material 10 is restricted, so that the drying process can take place in only one portion, the frontal portion, of the entire length of the drying installation.

The invention is naturally not restricted to the embodiment described above by way of example, but can be subjected to modifications within the framework of the following patent claims.

PATENT CLAIMS

1. Drying installation, intended mainly for drying printing inks (12a) applied to a material (10) from a printing machine, including a transport arrangement (4) or transport path comprising a carrier for the material (10) through the drying installation together with a number of heat-radiating members (16,21) which are designed to dry and/or cure the printing ink applied to the material together with a number of holes (18) or nozzles to commit the passage of an air flow, characterised in that the respective heat-radiating members (16) are provided firstly to supply heat to the members (22) for heating up a flow of air (23) which is intended to pass through the holes or the nozzles (18) and to be directed by these towards the transport arrangement (4) and secondly to supply heat by radiation to the printing ink (12) applied to the material (10).

2. Drying installation as in patent claim 1, characterised in that the member (22) is made wave-shaped with upward facing portions (22b) and with adjacent wall portions (22c,22d) forming a space (24) enclosing heat-radiating members (16), the said space (24) being opened at the bottom towards the transport arrangement (4).

3. Drying installation in accordance with any of the preceding patent claims characterised in that means designed to give off heat from metal to air are provided adjacent to the downward facing portions of wall portions

(22c,22d).

4. Drying installation in accordance with any of the preceding patent claims characterised in that the member (22) is provided with plane downward facing and upwarding facing portions and plane wall portions.

5. Drying installation in accordance with any of the preceding patent claims characterised in that the heat-radiating member (16) comprises a member emitting infra-red radiation and that a flow of air is provided on each side of the member so as to reduce the temperature rise of the printing ink and of the material.

6. Drying installation for drying printing ink (12a) which is curable by infra-red rays, ir-rays, applied to a material (10) from a printing machine, including a transport arrangement (4) or path forming a carrier for the material (10) through the drying installation together with a number of ir-radiating members (16,21) intended for drying and/or curing of the printing ink applied to the material plus a number of holes (18) or nozzles orientated between them and intended to permit the passage of an air flow, characterised in that the respective ir-radiating members (16) are arranged firstly to supply heat to members (22) for heating up an air flow (23) which is designed to pass through the holes or nozzles (18) directed towards the transport arrangement (4), between two ir-radiating members, and secondly to supply heat by direct radiation to printing ink (12) applied to the material (10),and that the member (22) is designed to firstly reflect heat rays, and secondly

to absorb heat, together with means for giving off the heat absorbed to the flow of air.

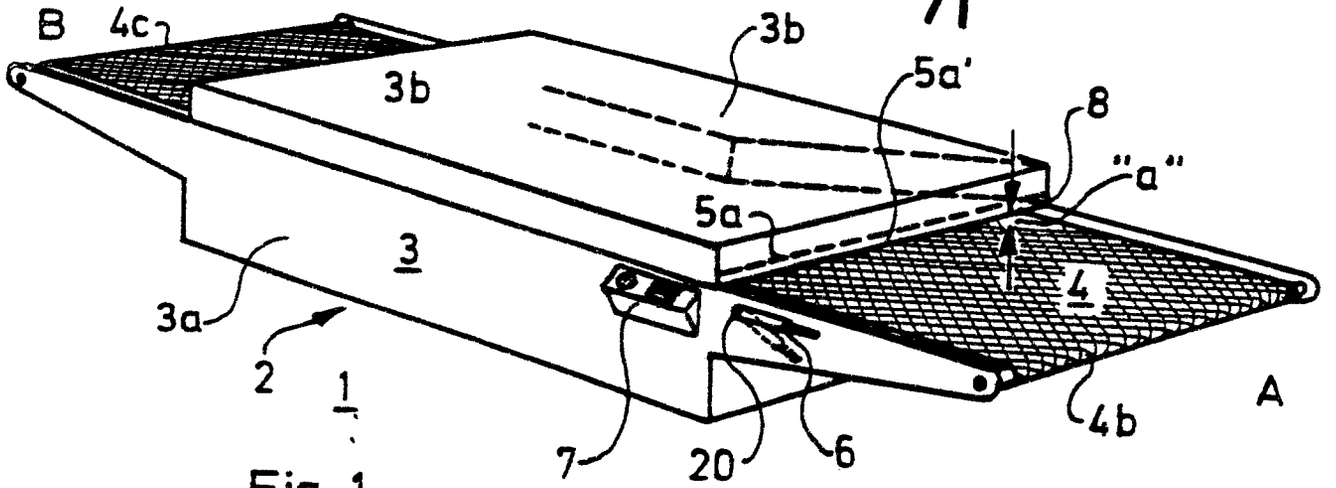

Fig. 1

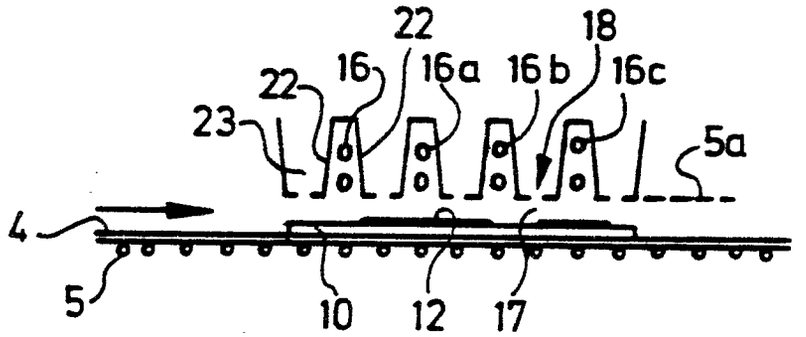

Fig. 2

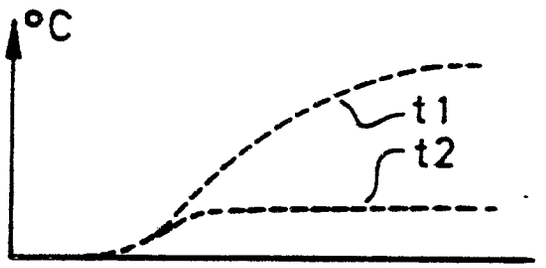

Fig. 3

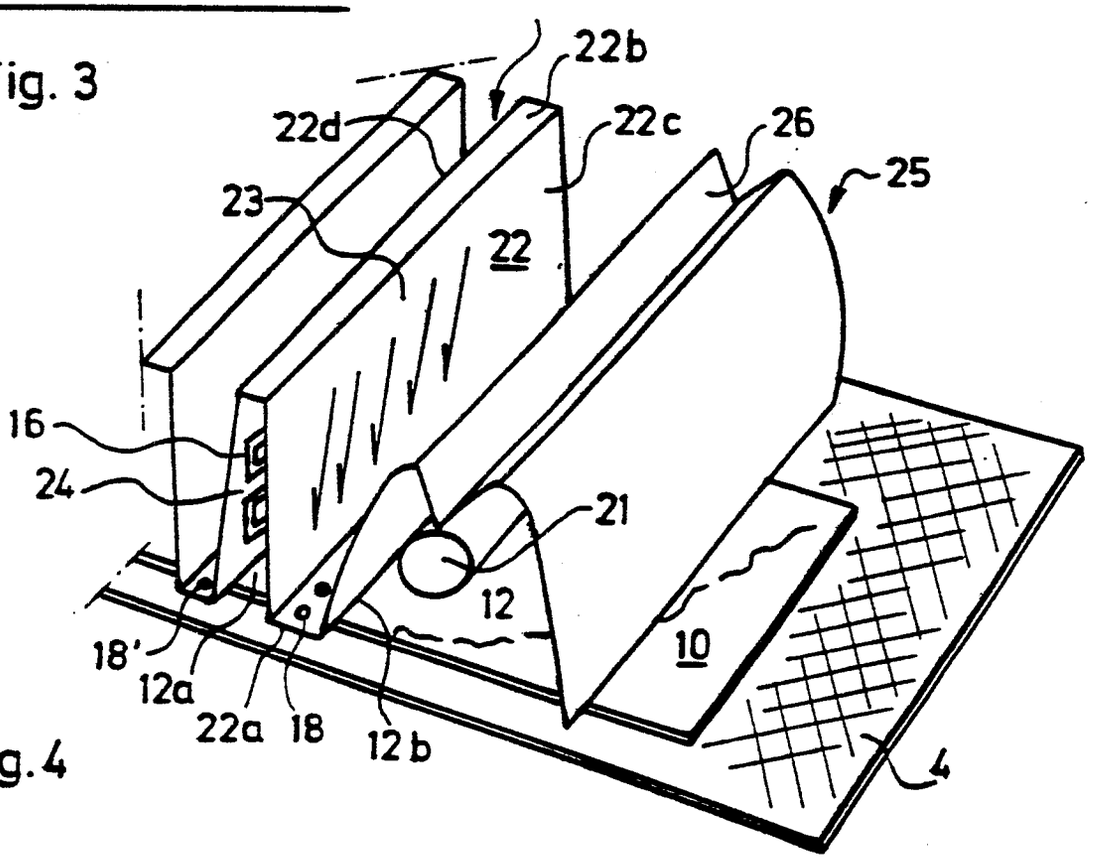

Fig. 4