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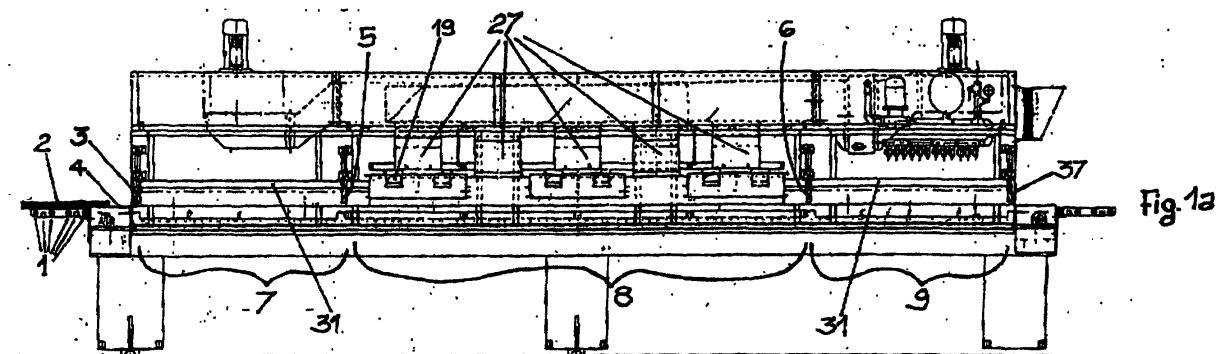
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(54) **Device for wood treatment**

(57) A device for drying of cold water paint on wood elements includes an environment (8) where the elements are placed in a microwave furnace with magnetrons, fitted to emit radiations in the spectrum of (2400-2500) MHz. with a radiation power comprised in

a range of (4,746-11,074) kW/m².

The internal environment of the device includes two attenuation chambers (7,9) and a treatment chamber (8); there are two fans (24,25) to breathe in air inside and to expel it.



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Description

[0001] The present invention concerns a machine for the working of components on solid wood, fit to be obtained even with its by-products (HDF, MDF, etc.) and/or veneered, in particular for the flash period/drying of paints applied on these components, including an environment where these components are placed for the process of the flash period/drying before proceeding to their assembling on furniture, walls and such.

[0002] The wood components destined to be used in the wood industry, on furniture, walls and such, are generally subjected to a painting treatment, articulated in several phases, each of them, in turn, articulated in one or more passages:

- at first the painting (fit to colour the wood component),
- then the application of the filler paint and,
- finally the application of the final coat of flat paint.

[0003] Till now the paints used on wood components, expected the presence of chemical solvents, which had the advantage to take short time for the flash period/drying of the treatment, but polluted both the work and the external environment, because of the fumes and the draining of paint waste.

[0004] To reduce the environmental impact, it was decided to turn to the use of cold water paints instead of paints with chemical solvents.

[0005] These cold water paints, obviously, do not pollute and are more easily used than the paints with chemical solvents, but present the disadvantage to request a considerably longer time for the flash period/drying than the paints with chemical solvents.

[0006] Consequently, the cold water paints involve a decidedly higher cost than the paints with chemical solvents, considering both of the labour and of the use of the painting plant and subsequent drying.

[0007] To proceed to the flash period/drying of wood components treated with cold-water paints, there are at the moment, furnaces consisting of tunnels, where these components are subjected to hot air currents, or to the exposure to infrared or U.V. lamps in an environment with controlled humidity.

[0008] It is necessary to underline that, there has already been for some time the attempt to introduce, in the industrial furnaces sector, plants exploiting the emission of electromagnetic radiations.

[0009] The start was with plants using a frequency around 27 Mhz.

[0010] Even if this attempt concerned furnaces in general, not connected specifically to the flash period/drying of cold water paints on solid wood components, it could have been almost certainly possible, if the results were positive, to address to this utilization.

[0011] Unfortunately, this attempt to introduce this technology based on industrial furnaces supplied by mi-

crowaves, with a frequency around 27 Mhz., has been soon abandoned for the critical results coming from the plant (critical control of the waves penetration inside the materials to treat, superficial formation of bubbles, etc.).

[0012] However the research and the development of industrial furnaces based on the emission of electromagnetic microwaves are left standing, non only in the radio-frequency field, but even in the microwaves one.

[0013] On the base of appropriate experimentations, examining the functional characteristics of an industrial furnace, based on the microwaves heating of materials, it was possible to find out that, in reality, the responsibility of the obtained results depended on the fact that the solution for the heating of a microwave furnace for industrial uses has been restricted to the only choice of the frequency of the electromagnetic radiations emitted by a magnetron.

[0014] It is therefore still extremely actual the definition of the functional characteristics of an industrial furnace supplied by electromagnetic waves, one of its utilizations could be addressed, for example, to the process of the flash period/drying of cold water paints on wood components and such, without forget, however, other utilizations.

[0015] Getting back to the problem of the drying of solid wood components, the purpose of the researchers team of a furnace fit to satisfy the requirements of the flash period/drying of cold water paints, was therefore that to examine closely the terms of the functional characteristics to give to a microwave furnace for industrial uses, to be able to arrive, by the way, to a substantial reduction of the installation and running expenses of this process, along with a substantial reduction of the time necessary for the same process.

[0016] As already mentioned, it was realized that one of the reasons of the failures depended on the fact that the definition of an only specification of the microwave furnaces for industrial uses, that of the frequency, was considered more important than others.

[0017] It was found out, in fact, that the only choice of an appropriate frequency risked not to solve the problems connected to this technology, because a plurality of other physical, chemical, mechanical, electrical quantities intervened in the achievement of an optimum result obtained from a microwave furnace for industrial uses.

[0018] Therefore, the problem the machine, according to the invention, wants to solve concerns the individuation of all physical, chemical, mechanical, electrical quantities which are interdependent and that consequently come into play in the definition of the specifications of an industrial furnace fit to heat an environment thanks to the utilization of the microwaves.

[0019] The problem of the flash period/drying of solid wood components painted with cold water paints, but even other problems connected to the possibility to use such thermic energy sources, is solved by the machine according to the invention, characterized by a combination of functional elements of an industrial microwave

furnace; such combination includes:

- one or more magnetrons fit to emit electromagnetic radiations in the spectrum of (2.400-2.500) MHz;
- waveguides made up of tubes fit to guide the electromagnetic radiations through the individuation of specific parameters of the waveguides,
- in particular:
- the tube length and, regarding a plurality of slots, a length, a width, an inclination as to the axial development of the tube, an axle base between two adjacent slots, a minimum distance between the fixing axis of the magnetrons and the axis of the first slot, and a placing of a cap at one of the extremities of the waveguide.

[0020] These and other characteristics will be clear from the following description and the enclosed drawings, where:

Pic. 1a,1b represent respectively a lateral view and a plan view of the machine according to the invention;

Pic. 2a,2b represent a frontal diagram and a section of an attenuation system of radio absorbent panels of the machine according to the invention ;

Pic. 3a,3b represent respectively the radiance device, the waveguide diagram and finally the section of the waveguide used in the machine according to the invention;

Pic. 4 represents a diagram of the ventilation system, the waterworks and of the treatment plant of the wood components of the machine according to the invention.

DESCRIPTION

[0021] According to the invention (Pic. 1a,1b) the machine includes a face made up of six rollers 1, where a component 2 which has to be treated, is placed to be introduced inside the machine.

[0022] An entrance bulkhead 3 has the purpose to protect the external environment from the microwaves emission, as we will see further on. A sensor, not shown in the drawings, has the task to activate automatically the opening of the entrance bulkhead 3, as soon as it notices the positioning of the component 2, on the rollers 1.

[0023] At the same time a conveyor belt 4 is activated by the sensor, in order to introduce the component inside the machine. After such introduction, the entrance bulkhead 3 comes down automatically, in a way already known. It is necessary to specify that the internal environment of the machine is substantially divided by two bulkheads 5,6, in three parts; the first one consists of a first attenuation chamber 7, the second one of a treatment chamber 8, while the third one consists of a second

attenuation chamber 9.

[0024] Then the component enters the first attenuation chamber 7, through the bulkhead 3, and afterwards enters the treatment chamber 8 through the bulkhead 5, which opens automatically, in a way already known, when the bulkhead 3 closes.

[0025] The treatment chamber 8 expects the presence of a plurality of devices 11 for the emission of electromagnetic radiations (Pic. 1a,1b). In the drawings it is possible to see six devices 11, arranged two by two in a substantially frontal way, in order to allow the control of an appropriate power density radiated on the components to treat, as we will see further on.

[0026] In fact, the treatment chamber 8 is made up of three resonance cavities 12,13, 14 and of two ventilation zones 16,17, which functionality will be explained further on.

[0027] In each resonance cavity there are at least two emission devices 11, each of them made up of a magnetron 18 and a waveguide 19 (Pic. 3a,3b,3c).

[0028] Each waveguide 19 consists of a metal tube 21 with a substantially rectangular section, where a magnetron 18 is fixed at the left end.

[0029] Such section measures respectively 86,36 +/- 0,20 mm in width, 43,18 +/- 0,25 mm. in height, with a sheet's thickness of 2 mm.

[0030] The tube 21 is supplied by a plurality of slots 22, placed on an only tube's wall in the direction of the component to treat.

[0031] Laboratory experimentations have allowed to define the dimensional characteristics of the tube 21, whose length has been individuated in a range of (1400-1500) mm., while, concerning the slots, each one has:

- a length comprised in a range of (55-70)mm.,
- a width comprised in a range of (3-8) mm.,
- an inclination as to the axial development of the tube 21, comprised in a range (8-16)°,
- of an axle base between two adjacent slots comprised in a range (82-90)mm.,
- a minimum distance between the fixing axis of the magnetron and the axis of the first slot 22 comprised in a range of (220-240) mm.,
- and finally the placing of a cap 23 at the other extremity of the waveguide 19 as to the placing of the magnetron 18, and comprised in a range (82-90) mm. as to the axis of the last slot 22.

[0032] In Pic. 3b, the number of the slots 22 is fourteen, but it is necessary to fix it every time, considering the choice of the parameters above mentioned The waveguide 19, fixed in this way, allows to distribute uniformly a radiate power on the component 2, as we will explain further on.

[0033] The treatment chamber 8 is crossed by an air flow supplied by two fans 24,25 (Pic.4), the fan 24 breathes in air from the outside. The air is treated,

through a water exchanger 26, then it is directed inside each resonance cavity 12,13,14. The fan 25 breathes in air from the ventilation zones 16,17 to expel it outside.

[0034] Therefore the treatment chamber 8 is subjected to a humidity and other volatile substances removal, caused by the flash period/drying of the component 2, together with the heat removal.

[0035] It is clear that the treatment chamber 8 of the component, is divided into three resonance cavities 12,13,14 (see Pic. 1a,1b), alternated with the two ventilation zones 16,17.

[0036] In order to block the emission of electromagnetic waves from the treatment chamber 8 through the ventilation ducts 27, at the entrance of each duct it is expected an attenuation grid.

[0037] This attenuation grid is made up of a drilled sheet-steel or black sheet, for it appropriate laboratory tests have led to the definition of the following dimensional characteristics:

- the percentage of empty space lower of 50% of the total surface of the sheet,
- hole diameter comprised in a range of (4,0-7,5) mm.
- axle base between the holes in a range of (8-15) mm.

[0038] The five attenuation grids, fixed in this way, allow the air passage but not that of the microwaves, because the five grids are linked to the emission frequency of the same microwaves.

[0039] The component 2 crosses the resonance cavities 12,13,14 and the ventilation zones 16,17 and, once the treatment comes to an end, it is opened automatically the bulkhead 6 which divides the treatment chamber 8 from the second attenuation zone 9.

[0040] The articulation and the placing of the resonance cavities 12,13,14, together with the waveguides arrangement 19 guarantee an appropriate and homogeneous power density radiated from the magnetrons 11 on the components 2 to treat, such density is comprised in a range of (4,746-11,074) kw/mq.

[0041] In correspondence of the two attenuation zones 7,9, it is expected the presence of radio absorbent panels 31 (Pic. 2), made up of two walls 32, at least one of them, the one interested by the radiations, made of Plexiglas, in order to guarantee the transparence to the radiations, whereas the other can be metallic. Between the two walls some spacers-switches 33 are interposed, which oblige a water flow, supplied by an entrance and an exit hole 34,35, to cross all the panel surface in a forced course, supplied by an electropump 36, fit to supply even the exchanger 26 (Pic. 4).

[0042] From laboratory tests, it is resulted that the attenuation grids and the radio absorbent panels 31 guarantee in a substantially reliable way the absence of the microwaves emission from the treatment chamber 8, so the above grids and panels are defined means of protection against the danger of microwaves emission.

[0043] At the closure of the bulkhead 6, it is opened automatically an exit bulkhead 37, whose functional character is analogous to the entrance bulkhead 3.

[0044] The conveyor belt 4 is made up of bearing material in polyester, while the surface is in Mylar so that to form a layer with a thickness of 1,5 cm. and a capacity of elastic resistance which is appropriate to the deformation and of a mechanical resistance which is appropriate to the weight of the component to treat.

[0045] According to the invention the machine works in the following way.

[0046] The component 2 to treat, just painted, is placed on the rollers 1 and then the feed of the conveyor belt 4 is grafted on automatically. The component enters the attenuation chamber 7 through the entrance bulkhead 3, which closes as soon as the following bulkhead 5 opens.

[0047] The radio absorbent panels 31 guarantee that, inside the attenuation chamber 7, the electromagnetic waves do not come out from the machine, when the bulkhead 3 is opened. Therefore, these panels represent blocking means of the microwaves emitted by the magnetron 18. At this point, the component 2 enters the treatment chamber 8, to be subjected to the electromagnetic radiation emitted from the magnetron 18 through the waveguides 19.

[0048] The fans 24,25 (Pic. 4) induce an air flow destined to the removal of the humidity and other volatile substances, which form inside the chamber 8, in addition to a substantially effective cooling action of the chamber area 8 and of the components 2.

[0049] Each component 2, once crossed the first resonance cavity 12, enters the first ventilation zone 16, then enters the second resonance cavity 13 and then still in a second resonance cavity 17 and finally in the third resonance cavity 14.

[0050] Thanks to the alternation of these treatments, it is possible to obtain the overall process of the flash period/drying of the painted components.

Claims

1. machine for the working of components (2) on solid wood, fit to be obtained even with its by-products (HDF, MDF, etc.) and veneered, in particular for the flash period/drying of paints applied on these components, including an environment (8) where these components are placed for the process of the flash period/drying before proceeding to their assembling on furniture, walls and such, **characterized by** a combination of functional elements of an industrial microwaves furnace, such combination is fit to include:
 - one or more magnetron (18) fit to emit electromagnetic radiations in the spectrum of (2.400-2.500)MHz.;

- waveguides (19) made up of tubes (21) fit to guide the electromagnetic radiations through the individuation of specific parameters of the waveguides (19), in particular:
 - a) tube length (21) comprised in a range of (1400-1500) mm. and, concerning a plurality of slots (22),
 - b) length comprised in a range of (55-70) mm.
 - c) width comprised in a range of (3-8) mm.
 - d) inclination as to the axial development of the tube comprised in a range of (8-16)°,
 - e) an axle base between two adjacent slots, comprised in a range of (82-90)mm.
 - f) minimum distance between the fixing axis of the devices (11) and the axis of the first slot (22) comprised in a range of (220-240) mm.
 - g) placing of a cap (23) at one of the waveguide extremities (19) comprised in a range of (82-90) mm. as to the axis of the last slot (22).
- 2. Machine as in 1, **characterized by** what this waveguide (19) allows to distribute on the component (2) a radiate power comprise in a range of (4,746-11,074)kW/mq.
- 3. Machine as in 1,2, **characterized by** an internal environment (7,8,9), subdivided in three parts by means of two bulkheads (5,6), the first part is made up of a first attenuation chamber (7), the second one by a treatment chamber (8), the third one by a second attenuation chamber (9).
- 4. Machine as in 3, **characterized by** what that this chamber (8) consists of three resonance cavities (12,13,14) and of two ventilation zones (16,17).
- 5. Machine as in 4, **characterized by** what that this treatment chamber (8) is crossed by an air flow supplied by two fans (24,25), the fan (24) breathes in air from the outside, to address it inside each resonance cavity (12,13,14), whereas the fan (25) breathes in air from the ventilation zones (16,17) to expel it outside, such air flow is fit to achieve an action of humidity and other volatile substances removal, caused by the flash period/drying of the component (2), together with a heat removal
- 6. Machine as in 1, **characterized by** protection means against the danger of microwaves emission, these means are made up of attenuation grids and of radio absorbent panels (31).
- 7. Machine as in 3, **characterized by** attenuation grids, made up of drilled sheet-steel or black sheet, these grids are fit to be defined by the following dimensional parameters:
 - percentage of empty space not higher of 50% of the total surface of the sheet;
 - holes diameter comprised in arrange of (4,0-7,5) mm.
 - axle base between the holes comprised in range of (8-15)mm. these grids are fit to allow the air passage, but not of the microwaves.
- 8. Machine as in 3, **characterized by** the radio absorbent panels (31) consisting of two walls (32), at least one of them, that interested by radiations, is made up of Plexiglas, in order to guarantee the transparence to the radiations, while the other can be metallic, between these walls spacers-switches (33) are interposed, fit to oblige a water flow, supplied by an entrance and an exit hole (34,35), to cross all the panel surface in a forced course.
- 9. Machine as in 1, **characterized by** a conveyor belt (4) of the component (2), this conveyor belt is made up of a bearing material in polyester, whereas the surface is in Mylar, in order to form a layer with a thickness of 1,5 cm. and a capacity of elastic resistance which is appropriate to the deformation and of mechanical resistance, appropriate to the weight of the component to treat.
- 10. Machine as it results from the description, from the enclosed drawings and from the claims 1-9.

TAB. 1

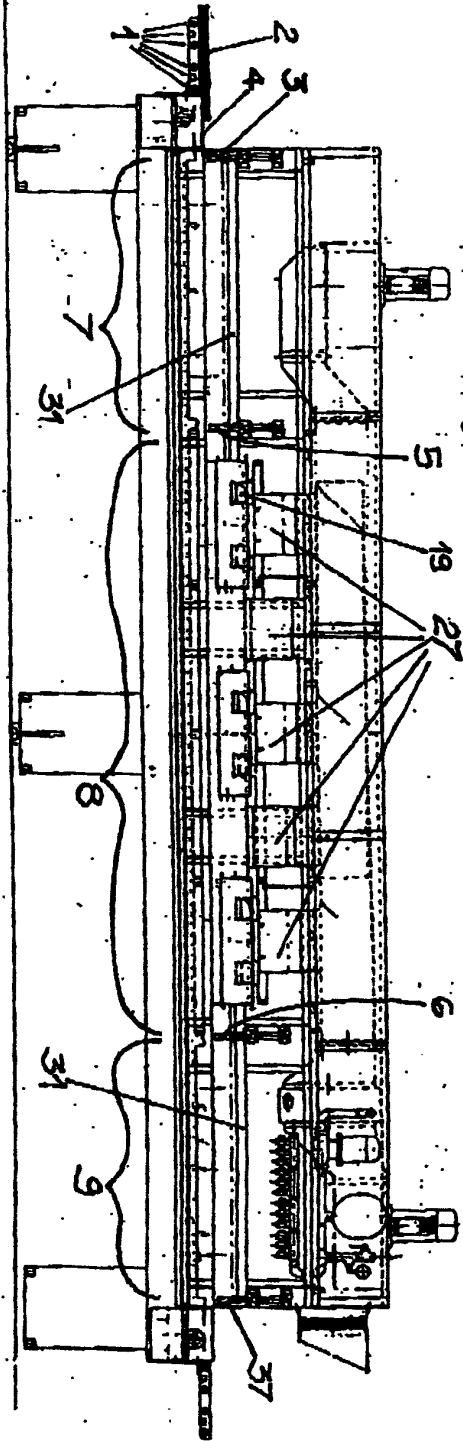


Fig. 13

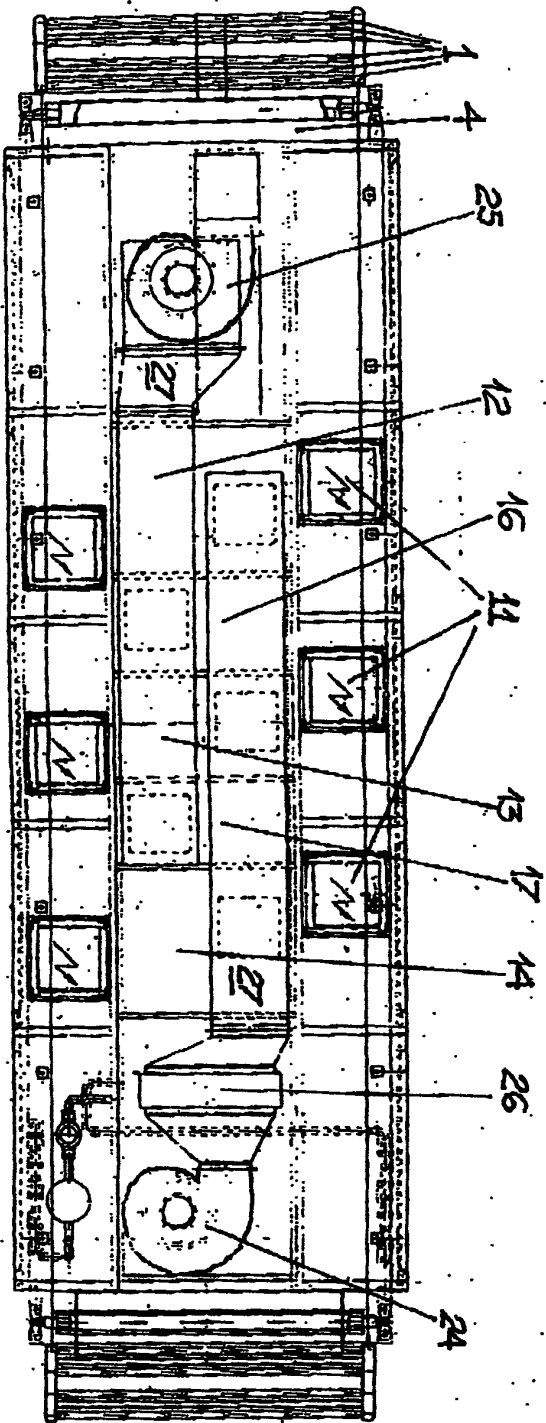
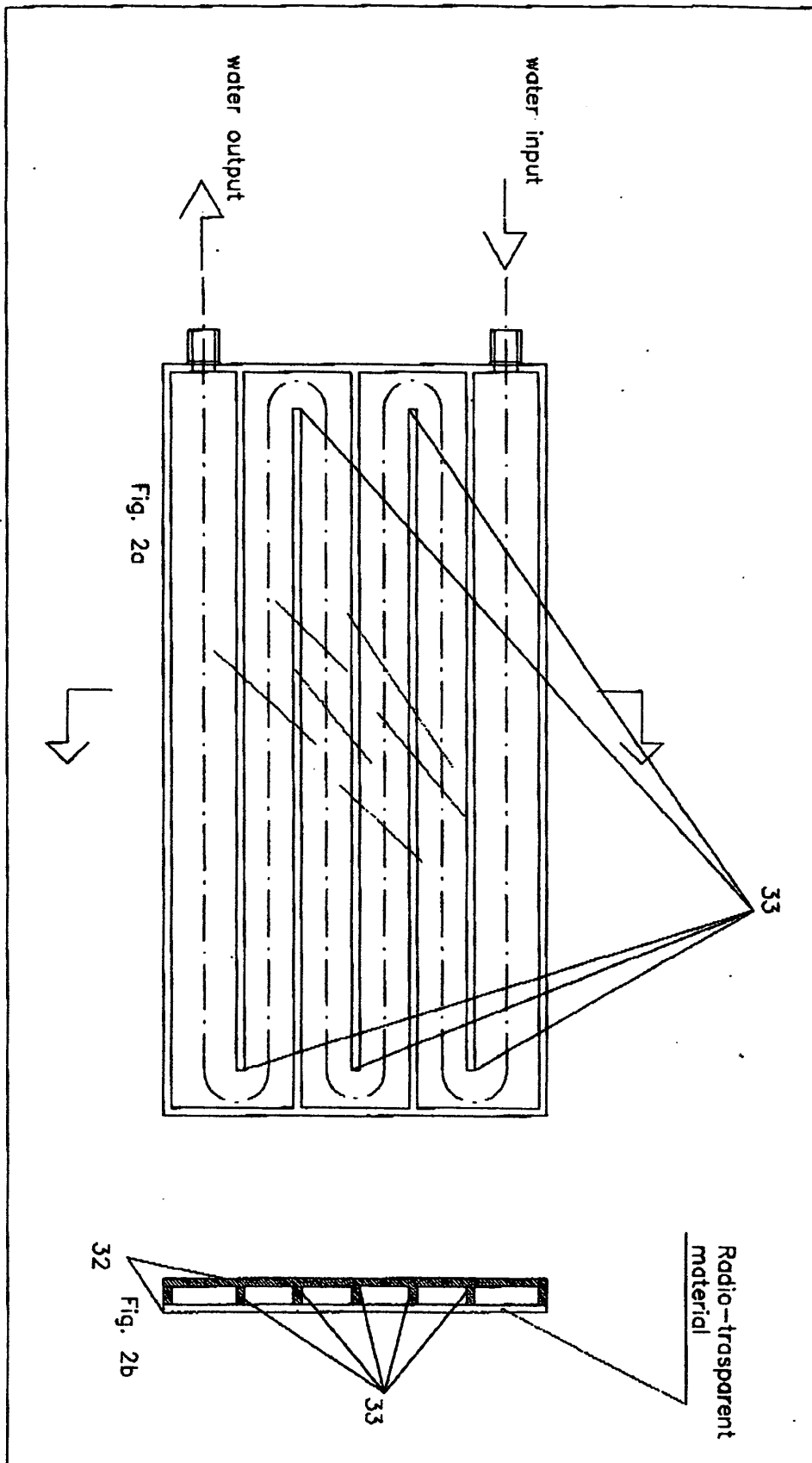


Fig. 1b

TAB. 2



TAB.3

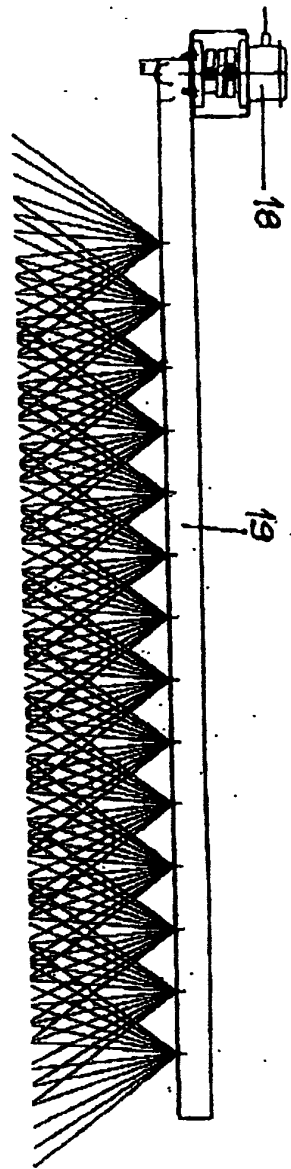


Fig. 3a

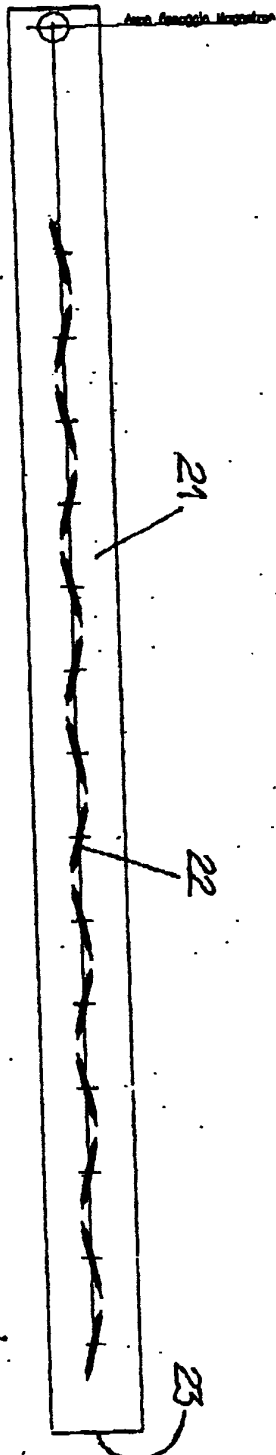


Fig. 3b

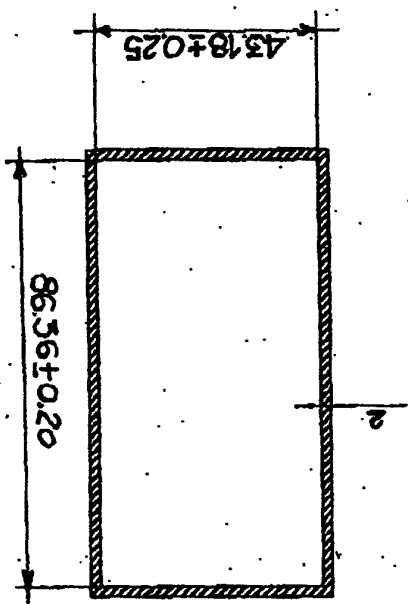


Fig. 3c

TAB. 4

