(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 039 095
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 81200335.8

(51) Int. Cl.³: B 27 K 5/02

(22) Date of filing: 26.03.81

(30) Priority: 31.03.80 IT 2107380

(43) Date of publication of application:
04.11.81 Bulletin 81/44

(84) Designated Contracting States:
AT BE CH DE FR GB LI LU NL SE

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(54) Method and apparatus for dyeing sheet materials, more particularly wood in sheet form.

(57) A method and an apparatus for dyeing materials in sheet form, such as wood sheets, are based on the formation of a roll (14) comprised of a liquid-pervious pliable web (16) on which wood sheets (15) are placed and the introduction of said roll (14) into an autoclave (1) in which dyeing is carried out at a temperature of 130°C - 140°C and under a high pressure, preferably obtained by causing a back-pressure in the dyeing liquor stream to take place, the flow of the liquor being caused to run longitudinally of the roll (14).

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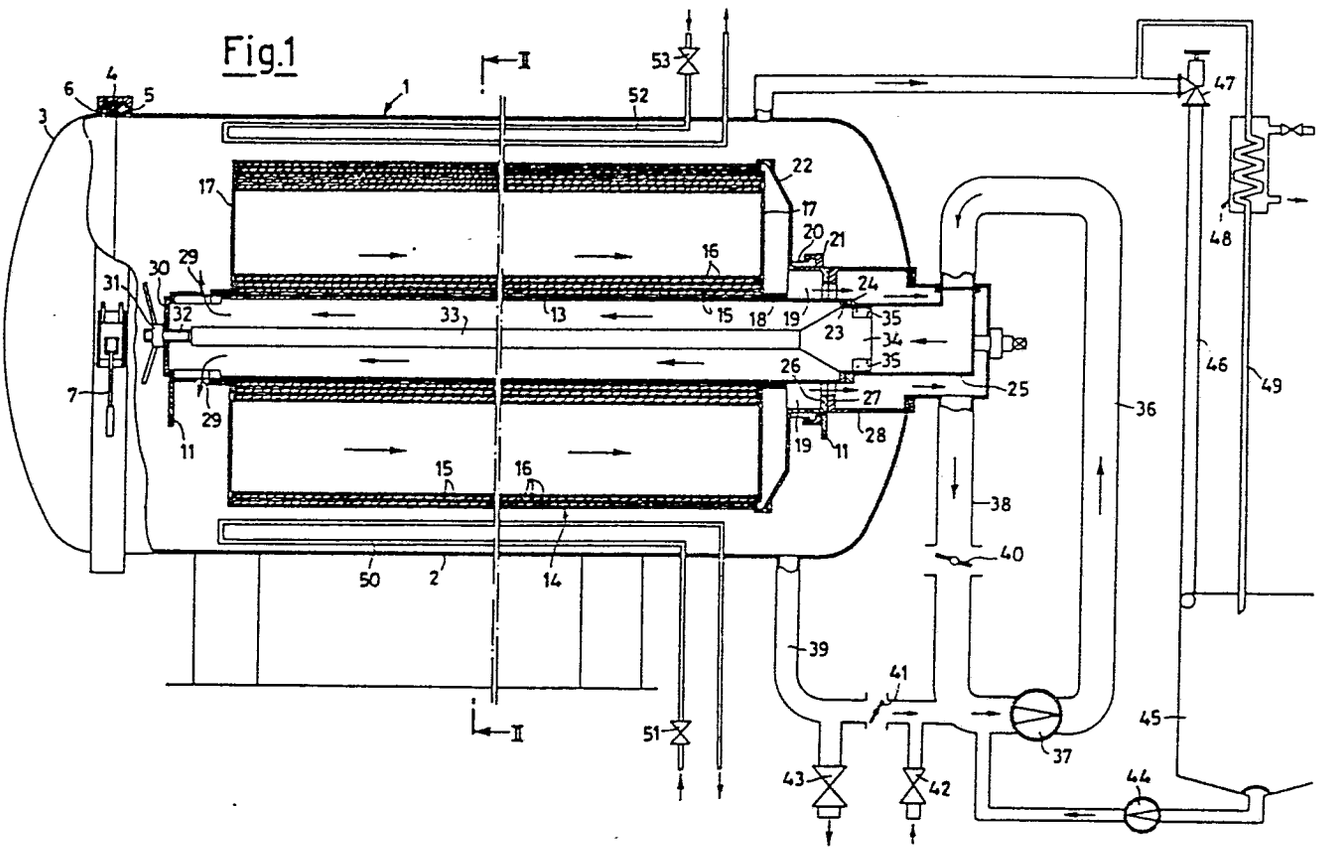
Fig.1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METHOD AND APPARATUS FOR DYEING SHEET MATERIALS, MORE PARTICULARLY WOOD IN SHEET FORM . -

This invention relates to a process and an apparatus for dyeing, with the absorption method, sheet materials, more particularly wood in sheet form of various thicknesses and sizes.

The present technology of absorption dyeing for wood in sheet form prescribes to charge the wood sheets to be dyed in superposed relationship on specially provided frames having cables or other means for spacing apart the sheets from each other, so as to enable the dyeing liquor to reach each and every point of the wood sheet to be dyed. If the several sheets are not so spaced mutually, the contacting surfaces, in fact, would not be touched by the dyeing liquor, so that they could not absorb it and would not be dyed.

It is possible to attain the same results by inserting between adjoining wood sheets a spacing gauze : this can be of a plastics or a synthetic material and must be anyhow capable of allowing the liquor to attain all the surfaces to be dyed.

Both in the first and the second case aforesaid, the wood sheets are subsequently placed in tubs of an appropriate size equipped with a steam heating

system or a heating system using another fluid. The necessary dyeing solution is then introduced in said tubs, whereafter the liquor is heated to an appropriate temperature (the boiling point temperature of the liquor as a maximum). The material is then held soaked in the liquor during a certain number of hours to enable the wood to absorb, more or less evenly, the dyestuff contained in the tubs in solution.

Such a dyeing method has certain defects, which can be summarized as follows :

- a high cost of workmanship
- high percentages of breakages of sheets during loading into and discharging from the bath
- lengthy dyeing times (8 to 12 hours and even more, according to the material wall thickness)
- high volume of the dyeing bath relative to the wood loaded in the tubs
- high residues of dyestuffs and auxiliary products
- high bulk of the installations and thus a great space demand.

An object of the present invention is to provide a process and an installation for dyeing wood in sheet form, or any other like material, said method being unaffected by the above enumerated drawbacks and susceptible of affording a higher efficiency at reduced costs.

Having this object in view, the process according to this invention is characterized in that it pro-

vides for arranging the sheets to be dryed, in succession, on a web of a pliable, liquid-pervious material, wrapping said web with the sheets superposedly placed thereon about a supporting axle, charging the thus formed roll in the interior of an autoclave and subjecting said roll to an axially flowing stream of dyeing liquor at high temperatures and under high pressures.

The installation according to the invention, in its turn, is comprised of a supporting axle structure for the wrapped material and an autoclave equipped with means for receiving said supporting axle structure and the roll wrapped therearound and means for originating a flowing stream of dyeing liquor at a high temperature and pressure for flowing through said roll in the axial direction.

It has been ascertained that with the process and the installation according to this invention, the following outstanding results have been achieved :

- reduction of the dyeing times up to 75%
- reduced cost of labour
- improved output of dyed material (up to three times) for the same duration of the treatment
- lesser amount of residues of dyestuffs in the spent dyeing liquor
- improved evenness of dyeing since the dyeing liquor is thrust under pressure into the wood interstices
- a considerably reduced bulk of the installation

for the same amount of material to be dyed.

An example of practical embodiment of the installation for performing the method according to the invention is shown, to afford a better understanding, in the accompanying drawings, wherein :

FIGURE 1 is an axial vertical cross-sectional view of the autoclave in which the dyeing operation of the material is carried out, taken along the line I-I of FIGURES 2 and 3.

FIGURE 2 is a view of the autoclave in cross-sectional view, taken along the line II-II of FIGURE 1.

FIGURE 3 shows the autoclave in lengthwise cross-sectional view, taken along the line III-III of FIG. 2.

FIGURE 4 shows the autoclave in cross-sectional view taken along the line IV-IV of FIGURE 3.

FIGURE 5 is a diagrammatical frontelevational view of a device for the formation of the roll of sheet material to be dyed, to be subsequently introduced into an autoclave such as shown in the preceding FIGURES of the drawings, and

FIGURE 6 shows the roll-forming device in top plan view.

Havig now reference to FIGURES from 1 to 4 inclusive an autoclave, 1, is shown, as formed by a hollow cylindrical body 2, closed at either end by a lid 3 locked by a latching system comprised of a strap 4 having a C-shaped cross-sectional outline and which straddles matching flanges 5 and 6 of members 2 and 3, said

strap being circumferentially latched by a latching member 7 of the lever type (FIGURE 1).

In the interior of the cylindrical body 2, there are secured two longitudinally arranged rails 8, which support and guide, by the agency of idlers 9, a carriage 10: the latter is comprised of two header pieces 11, mutually connected by longitudinally running bars 12 (FIGURES 2-4).

Each of the two header pieces 11 of carriage 10 supports a corresponding end of a cylindrical member, or drum, 13, about which a roll 14 is wrapped, which is formed by sheets of the material to be dyed, 15, arranged in succession in end-to-end relationship on a gauze web 16 which acts like a spreader.

The roll 14 is retained between two foraminous and discs 17, one of which (at the right as viewed in FIGURE 1) has its hub 18 abutting a circumferential sequence of radial gills 19 which latter connects, rigidly, the corresponding end of the drum 13 to a coaxial ring structure 20 directly supported by the corresponding header 11 of the carriage 10. The ring 20 has, secured thereto by the C-shaped strip 21 (equipped with an appropriate latching means) a header 22 which axially and transversally confines the roll 14 (FIGURE 1).

Such end of the drum 13 is open and matches through a flange 23 a corresponding flange 24 of a fixed tube 25 emerging from the autoclave 1.

Likewise, a flange 26 of the ring 20 coaxial with

the drum 13 matches a corresponding flange 27 of the tube 28 which is fixed and coaxially arranged about the tube 25 aforementioned and emerges also from the autoclave 1.

The opposite end of the drum 13 has, in its turn, a circumferential succession of openings 29 and is frontally closed by a dish 30: the latter is urged against the drum 13 (and this against the fixed tubes 25 and 28) by means of a fly-nut 31 screwed onto a screw-threaded end portion 32, of a stud 33 passing through axially of the drum 13 and secured by flags 34 and tabs 35 to the fixed tube 25.

The inner fixed tube 25 is connected by an outer tubing 36 to the delivery side of a pump 37, the intake side of which is connected to the external fixed tube 28 and to the autoclave section surrounding the tubes 25 and 28 via pipings 38 and 39 which are controlled by attendant butterfly valves 40 and 41. Two conduits, 42 and 43, are located downstream and upstream, respectively, relative to the valve 41 for the initial filling of the autoclave with an appropriate dyeing liquor, and for discharging said liquor, respectively, at the end of the dyeing step. Another pump, 44, has its delivery side connected to the intake side of the pump 37, whereas the intake side is connected to the bottom of a vessel 45: this vessel, in turn, is connected to the top section of the autoclave 1via a piping 46 equipped with a regulation valve 47. A cooling system, 48, is also

provided, which is inserted in a piping 49 in parallel relative to the valve 47.

Lastly, the autoclave 1 is equipped with a heating coil 50 to be fed with steam or another heating fluid under the control of a valve 51 , and a cooling coil 52 is likewise provided, which is fed with water or another coolant under the control of a valve 53 (FIGURES 1 and 2).

For the formation of the roll 14, the use of the device shown in FIGURES 5 and 6 is provided. The device in question is comprised of a fixed bed 54 which supports two pairs of wheels 55 intended for supporting and driving to rotation the drum 13 on which the roll is to be formed, and a bed 56, which idly supports the roller 57 for sustaining a starting roll of gauze 58 and can be displaced parallely of the axis of the wheels 55 for providing a transversal adjustment of the roll 58 relative to the drum 13. The roll 57 is engaged by a slanting guide member 59, at the bottom end of which there is arranged a roll 60 intended to drag the gauze roll 16 from the roll 58. Through an array of fixed rollers 61 - 66 between which tightening rollers 67, 68 (carried by a swinging arm 69) are arranged, the gauze web 16 is transferred from the feeding roller 60 to an incline 70 : said incline is controlled by a hydraulic jack 71 for progressively rotating about the axis of the roller 66 from the position shown in dash-and-dot line in FIGURE 5 to the position shown in solid lines

in the same FIGURE as the wrapping of the web 16 about the drum 13 proceeds. In the zone above the incline 70 the web 16 receives the wood sheets 15, arranged in succession as shown in FIGURES 5 and 6 and then they are wrapped together with the gauze 16 until the formation of the roll 14 is completed.

The dyeing step takes place, as a rule, as follows : The gauze web 16 is gradually paid off of the roller 58, the supporting hub of which, 57, thus gradually approaches the delivery roller 60 and falls along the guide 59. After having received the wood sheets 15 in the area above the incline 70, the gauze web 16 is wrapped together with the wood sheets about the drum 13 and the roll 14 is thus formed. The roller 71 controls the gradual fall of the incline 70 so as to hold the web 16 always tangentially of the roll 14 in the point where the wrapping stage is started.

The roll thus prepared, completed with its foraminous discs 17 and headers 22, is placed on a carriage such as that shown at 10 in FIGURES 1 to 4: carriage 10, by means of another carriage, is then conveyed to the mouth of the cylindrical section 2 of the autoclave and is slipped thereinto and caused to roll over the guides 8. The end flanges 23 and 26 of the drum 13 and the ring 20 are brought to engage the fixed flanges 24 and 27 (appropriate gaskets being inserted therebetween), respectively, and the whole assembly is latched in the desired position by tightening the fly nut 31 onto the

screw-threaded portion 32 of the stud 33 and thus against the dish 30.

At this stage, upon closing and tightening the lid 3, the autoclave is filled with the dyeing liquor, that is an aqueous solution of dyestuff, via the valve 42, the pump 37, the piping 36, the pipe 25, the inner space of the drum 13 and the openings 29 of the left end (as viewed in FIGURE 1) of the drum.

Upon closing the filling valve 42, the pump 37 maintains the flow of the dyeing liquor by feeding it into the interior of the drum 13 and causing it to emerge therefrom as outlined above ,so that the liquor is forced to flow the roll 14 longitudinally prior to returning to the pump 37 via the conduit 28, 38 under the control of the valve 40. The liquid fraction which does not flow through the roll 14 is returned, conversely, to the pump 37 via the conduit 39 controlled by the valve 41.

While the heating coil 50 administers to the dyeing liquor the heat as required for attaining the expected temperature (up to 140°C), an appropriate setting of the butterfly valves 40 and 41 provides an outlet back-pressure which originates a rise of the pressure of the liquid flowing through the roll 14 up to a high value such as for example, 5 bars. The dyeing liquor is thus compelled to reach evenly and at a high temperature all the interstices of the wood and a satisfactory finishing is thus achieved.

The pump 44 is intended for originating in the in-

terior of the autoclave such a static pressure as to enable the liquor to attain temperatures in the order of magnitude of 130°C - 140°C without having the liquor brought to a boil. The pump 44 has its intake side connected with the vessel 45 which acts like an expansion pot and receives liquor from the autoclave, when the valve 47 is closed, through a cooler 48 which is intended for lowering the liquor temperature to about 60°C - 70°C. The pump 44, moreover, permits that possibly added dyestuffs introduced in the vessel 45 may be introduced in the autoclave, in spite of the latter being pressurized. The piping 46, in its turn, is intended both for the initial de-aeration of the roll 14 and for feeding the vessel 45 with the water which is required for diluting possibly added dyestuffs.

It should be noted that the longitudinal flow of liquor urged through the roll 14 tends to impart thereto a rightward thrust, as viewed in FIGURE 1. This has the beneficial effect of keeping the roll 14 snugly against the right foraminous disc 17, whereas the left foraminous disc 17 is urged, in its turn, against the corresponding roll end. The assembly is thus well compacted and motionless. Provisions could be made, at any rate, for reversing the direction of flow of the dyeing liquor.

Once the dyeing step is over, the process being particularly advantageous due to the beneficial effects of the axial flow at high temperature and under a high

pressure through the roll of material to be dyed, the results being a reduction of the dyeing time, the improved output and an improved evenness of the colour of the end product, the dyeing liquor is cooled by the coil 52 and finally discharged through the valve 43.

C L A I M S :

1. A process for dyeing sheet materials, especially wood in sheet form, characterized in that it provides for arranging the sheets to be dyed, in succession, on a web of a liquid-pervious pliable material, wrapping said web with the superposed sheets thereon about a supporting axle, loading the thus formed roll into the interior of an autoclave and subjecting said roll to an axial flow of a dyeing liquor at a high temperature and under a high pressure.

2. An installation for dyeing materials in sheet form, more particularly wood sheets, characterized in that it comprises a supporting axle for wrapped materials and an autoclave equipped with means for receiving said supporting axle with a roll thereon and means for originating a flow of dyeing liquor at a high temperature and under a high pressure flowing through said roll in the axial direction.

3. Installation according to Claim 2, characterized in that said means for originating a stream of dyeing liquor comprise a first pump with the intake side and the delivery side connected with the inside of the autoclave by respective pipings, at least one of said pipings for connection comprising valve means adapted to originate a back-pressure against the flow of said dyeing liquor.

4. Installation according to Claim 3, characterized in that it comprises an additional pump having its deli-

very side connected to one of said connection piping of the first pump and having its intake side connected to the autoclave top by a piping equipped with a cooling means, said additional pump being so proportioned as to maintain the static pressure within the autoclave at such a value as to enable the dyeing liquor to attain a temperature above its boiling point temperature without entering a boil.

5. Installation according to Claim 3, characterized in that said supporting axle is in the form of a tube with openings at both ends and said means for originating a flow of dyeing liquor are so embodied as to originate a stream of liquor going from either end to the other of said tubular supporting axle in the interior of it and returning in the reverse direction, through said roll and vice versa.

6. installation according to Claim 2, characterized in that said supporting axle is equipped with foraminous discs mounted on said axle at the ends of said roll in order longitudinally to confine the position of said roll on said supporting axle.

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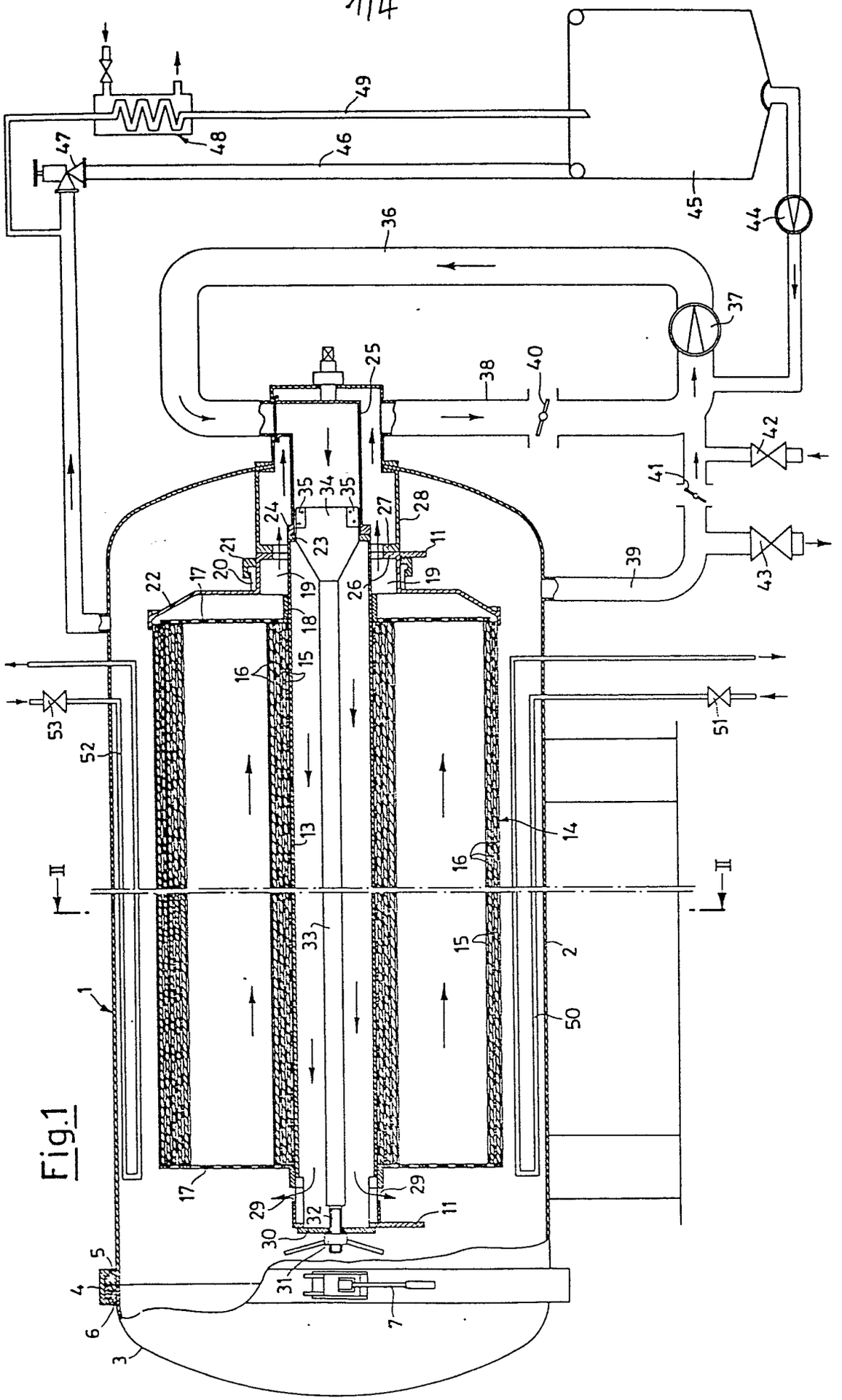

Fig.1

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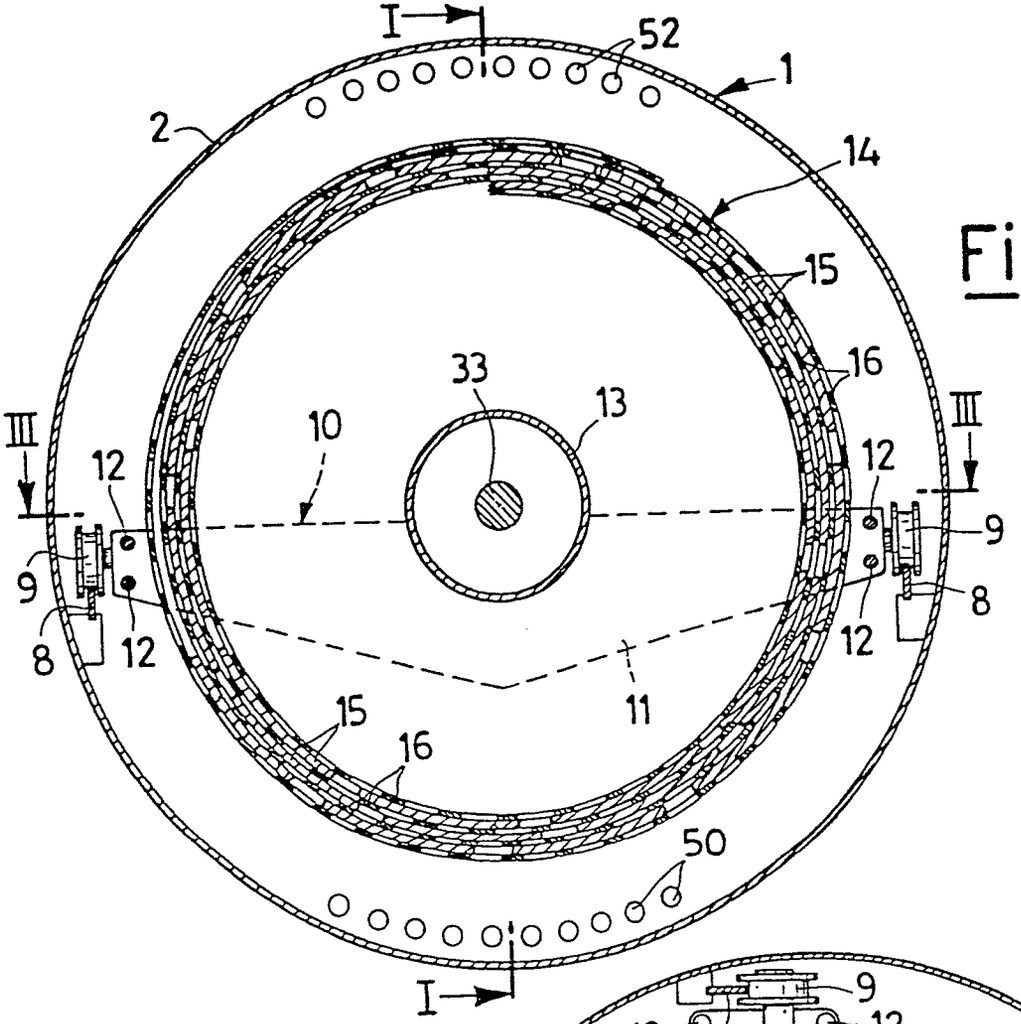

Fig.2

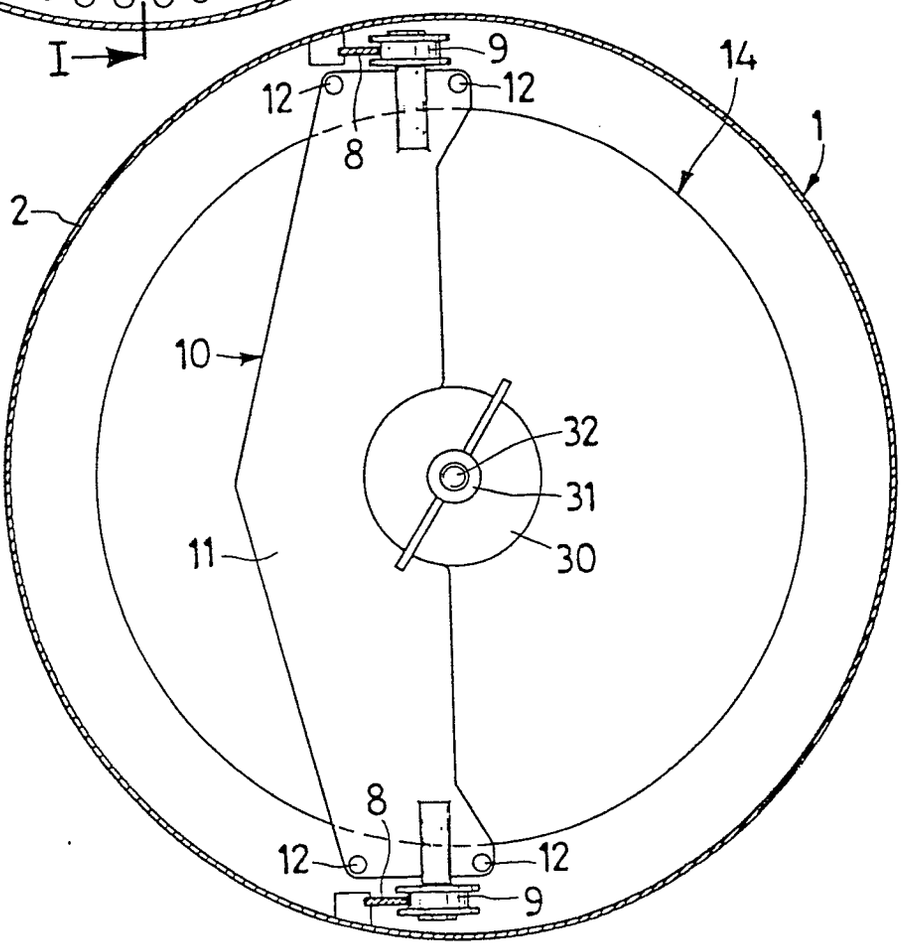

Fig.4

Fig.3

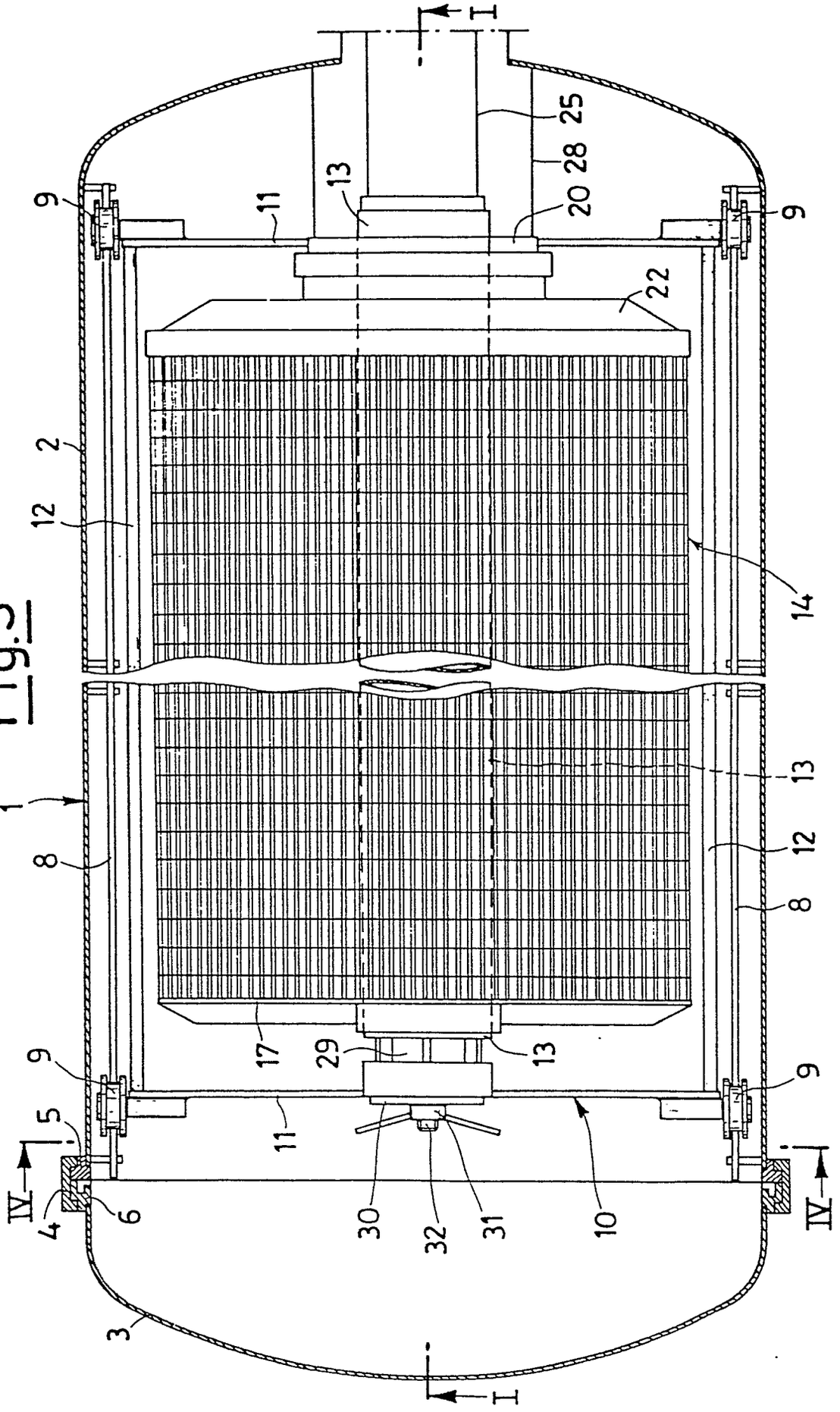

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Fig.5

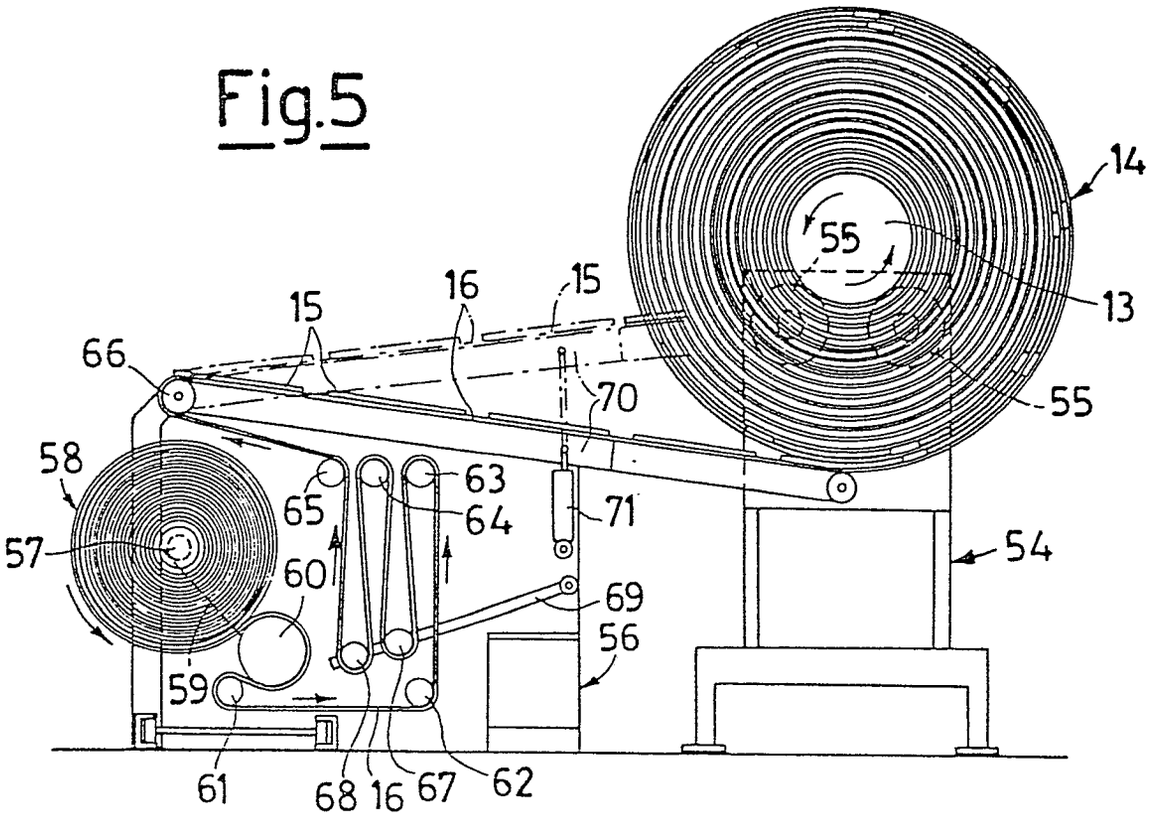

Fig.6