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54 **Submerged combustion apparatus to dye yarns.**

57 Submerged combustion apparatus (18-118) to dye yarns packaged on wound bodies such as tapered bobbins (12), hanks (30), cakes, laps, etc., which consists of a container (11-29) to hold the wound bodies and comprises means to immit (15) and to discharge (16) the dyebath, which is caused to circulate successively through the wound bodies, the apparatus (18-118) incorporating a combustion device (19) immersed in the dyebath to heat the same, the combustion device (19) being equipped with its own burner (20) fed (22-23-34-35) independently with gas and with its own outlet (27) for the products of combustion.

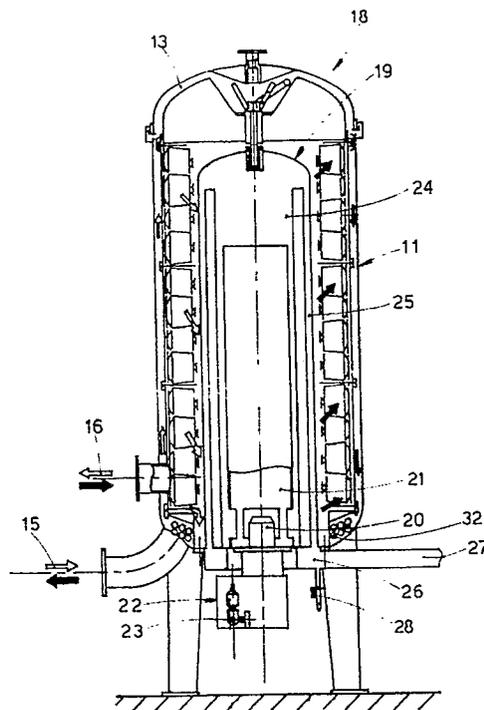


fig.3

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## SUBMERGED COMBUSTION APPARATUS TO DYE YARNS

This invention concerns a submerged combustion apparatus to dye yarns packaged on wound bodies such as tapered bobbins, hanks and the like.

To be more exact, the invention concerns a dyeing apparatus which is independent from the viewpoint of energy supply and structurally compact and can achieve a very high dyeing efficiency.

The apparatus of the invention is employed advantageously in dyeing processes which provide for the employment of dyeing machinery for wound bodies, such as autoclaves for bobbins, carrier vessels for hanks and the like.

The state of the art covers a plurality of dyeing apparatuses of the type with which this invention is concerned. A plurality of units of such apparatuses are normally included in the dyehouse and are never all working at the same time.

However, they always have available a heat-carrier fluid, superheated water or steam, to heat the dyebath.

So as to provide this service without interruptions, the dyehouse is equipped with a big heating plant and a distribution network for the heat-carrier fluid which often is also very long.

The above situation entails a low overall thermal efficiency of the dyehouse, which usually ranges from 60% to 65%, and high relative costs as an outcome.

Among the apparatuses normally employed in the dyeing of wound bodies should be mentioned the autoclave for yarns wound in bobbins; in the autoclave the bobbins of yarn are dyed by immersion in a dye solution or dyebath.

A traditional autoclave contains a coil-type heat exchanger to heat the bath with superheated steam or water, while an external pump provides circulation of the dye solution through the yarn packages.

There are substantially two types of autoclave for dyeing, which differ from each other in the way in which the material is positioned within them.

The yarn packages are stacked with a vertical axis in the first type in an appropriate material holder which takes up the central part of the autoclave.

In the second type the yarn packages are distributed with their axis horizontal on the inner peripheral surface of the autoclave and leave in this way a central space which is occupied by an appropriate plenum chamber, which reduces the dead space within the autoclave and has the purpose of reducing the ratio of the bath (litres of water per kilograms of material).

As we said above, these apparatuses are connected to a heating plant and the textile material

held in them undergoes a pre-set heating cycle according to a suitable system.

Instead, dyeing carrier vessels are employed in the dyeing of yarns wound in hanks and consist of a generally parallelepipedal vessel separated into compartments by partitions which are perpendicular to each other.

The hanks are loaded onto a series of metallic rods, thus obviating any tensioning of the hanks.

The bath is made to circulate alternately in ascending and descending directions within the compartments with methods and results substantially analogous to those of the autoclave.

The many steps of heating, keeping at an even temperature and emptying the hot bath so as to fill it thereafter with cold water causes the dyeing to be, with the above systems, a highly wasteful process from the energy usage point of view.

To improve the dyeing efficiency and overall energy balance, solutions have been proposed in which a dyeing apparatus is introduced into an independent circuit connected to a boiler providing direct heating of the dyebath.

Various configurations of plant have been proposed but have not been applied in practice since they are too bulky industrially and are decidedly expensive.

The present applicant has set himself the objective of providing a dyeing apparatus which overcomes the problems of the state of the art and is therefore able to offer a compact structure that is independent as regards energy supplies and makes possible lower dyebath ratios and high dyeing efficiency.

The invention is set forth in the main claim; while the dependent claims describe various features of the invention.

The apparatus of the invention includes a system for direct heating of the dyebath with submerged combustion, that is to say, the heating device is fully immersed in the means which has to be heated.

This submerged combustion apparatus according to the invention may be an autoclave or a hank carrier vessel or anything else suitable for the dyeing process.

By regulating the quantity of fuel mixture introduced into the combustion chamber it is possible to carry out the dyeing operation with differing speeds of increase of the temperature of the dyebath.

The speed of increase of the temperature is chosen by the dyer according to the type of material, the type of dyestuff and the results to be achieved.

The apparatus of the invention provides also a recovery of heat from the cooling of the fumes of combustion at the stack, the temperature being brought by the cooling below the dew point.

This cooling is obtained with the water which will be employed thereafter to fill the dyeing apparatus and which thus reaches beforehand a given temperature value, for instance about 40 ° C instead of the usual immission temperature of 15 ° C.

The heat efficiency found by the applicant with the apparatus of the invention falls substantially within a range of 93% and 98%.

These and other special features of the invention will be made clearer in the description that follows.

The attached figures, which are given as a non-restrictive example, show the following:-

Figs.1 and 2 are diagrams of the dyeing apparatuses of the state of the art;

Fig.3 is a diagram of an apparatus of an autoclave type according to the invention;

Fig.4 is a diagram of an apparatus of a hank carrier vessel type according to the invention;

Fig.5 shows a variant of the embodiment of the invention.

Fig.1 is a diagram of a dyeing apparatus of a known type consisting of a vertical autoclave 10. This autoclave normally consists of a cylindrical vessel 11 to contain the material to be dyed, tapered bobbins 12 in this example.

These bobbins 12 are stacked vertically to form several columns which are positioned in the central portion of the vessel 11 and are passed through in that position by the dye bath.

The bobbins are handled before and after the dyeing by a cover 13 of the vessel 11.

A coil-type heat exchanger 14 in which superheated steam or water coming from a suitable heat generator circulates is arranged within the vessel 11 and provides for the heating of the dye bath.

The dye solution is circulated within the vessel 11 and through the bobbins 12 by an external pump (not shown in the figure).

Circulation of the dye solution takes place alternately in two opposite directions shown with the arrows 15 and 16 in Fig.1, inwards and outwards respectively.

In Fig.2 the autoclave 110 contains the bobbins 12 arranged peripherally with a horizontal axis within the cylindrical vessel 11. The space left free in the central inner part of the vessel 11 is taken up by an appropriate plenum chamber 17 which has the purpose of reducing the dye bath ratio.

Fig.3 shows a diagram of an embodiment according to the invention, in this case at the base of an autoclave 110 of the type shown in Fig.2, but the autoclave could also be that 10 of Fig.1 with suitable adaptations.

The dyeing apparatus 18 according to the invention comprises in this case too a cylindrical vessel 11, horizontally arranged bobbins 12, a cover 13 and means to circulate the dye solution according to the arrows 15 and 16.

The apparatus 18 of the invention comprises a combustion device 19 in the central zone of the vessel 11 in the position occupied, for instance, by the plenum chamber 17 of the autoclave 110 of the state of the art.

The combustion device 19 includes in its lower portion a burner 20, for instance of the type using blown air, which cooperates with a combustion chamber.

The present applicant has found especially advantageous, but not exclusive, the employment of a dry combustion chamber 21 cooperating with the burner 20 together with a wet combustion chamber 24.

Air for the combustion is drawn from the exterior by a fan 22 and is mixed at the inlet of the burner 20 with gas coming from a valve 23.

The gas used may be of various types; the present applicant has found the use of methane particularly advantageous, from the point of view also of the plant used. He has also used and tried with good results liquid propane gas (liquid petroleum gas - LPG), but any other fuel of the state of the art can be employed.

The fuel gases pass from the dry combustion chamber 21 to the wet combustion chamber 24 and thence reach a heat exchanger 25 comprising tubes for fumes.

The burnt gases pass from the heat exchanger 25 to a collector 26, whence they are discharged through a pipe 27.

The water of condensation is collected in the collector 26 and discharged from an outlet 28.

A unit to cool the dye bath is referenced with 32.

Fig.4 is a diagram of a further embodiment of the invention, in which the dyeing apparatus 118 is a dyeing hank carrier vessel in this case.

The apparatus 118 consists of a vessel 29 within which hanks 30 are positioned and supported in a known manner. The dye bath is circulated to and fro by forced circulation within the vessel 29 and therefore through the hanks 30 according to the arrows 31.

Cooling coils 32 are normally included in the lower part of the vessel 29 to cool the dye bath.

A combustion device 19 analogous to that of Fig.3 and therefore bearing the same reference numbers is fitted in an upper part 33 of the vessel 29 and is immersed in the flow of the dye bath.

In any event the combustion device 19 can be fitted in any other suitable position in the flow of the dye bath within the apparatus 118.

Thus, for instance, the combustion device 19 and the cooling coils 32 could have their positions reversed.

According to the variant of Fig.5 a dyeing apparatus 18, here of an autoclave type fed with air 34 and gas 35, may be connected to a cooling unit 36 to cool the fumes of combustion leaving an outlet pipe 27.

The fumes are cooled to below dew point in a recovery and scrubber unit 37, wherein they meet wash water coming in the opposite direction according to the arrow 38 and entering along a pipe 39 into the upper part of the recovery and scrubber unit 37. The heated water is stored in tanks 40, whence it is drawn and delivered to its usage point according to the arrow 41.

This heated water is used advantageously to fill the autoclave 18 as it may have a temperature of about 40° C instead of the normal temperature of 15° C and in this way may permit a recovery of heat estimated by the present applicant to be about 10%.

Otherwise, the cooling unit 36 can be replaced by a simple vessel holding a mass of water to be heated; into this water are introduced for scrubbing the fumes of combustion.

Insertion of the combustion device 19 into into the dyeing apparatuses 18-118 entails obviously the inclusion of supplementary control, safety and protective devices in the apparatuses 18-118, but this forms part of the state of the art and can be readily understood by a person skilled in this field as well as many other possible variants without departing thereby from the scope of the invention as claimed.

## Claims

1 - Submerged combustion apparatus (18-118) to dye yarns packaged on wound bodies such as tapered bobbins (12), hanks (30), cakes, laps, etc., which consists of a container (11-29) to hold the wound bodies and comprises means to immerse (15) and to discharge (16) the dyebath, which is caused to circulate successively through the wound bodies, the apparatus (18-118) being characterized in that it incorporates a combustion device (19) immersed in the dyebath to heat the same, the combustion device (19) being equipped with its own burner (20) fed (22-23-34-35) independently with gas and with its own outlet (27) for the products of combustion.

2 - Apparatus (18-118) as claimed in Claim 1, in which the combustion device (19) comprises a combustion chamber, advantageously a dry combustion chamber (21) and a wet combustion chamber (24), a heat exchanger (25) comprising tubes for fumes and a collector (26) of burnt gases.

3 - Apparatus (18-118) as claimed in Claim 1 or 2, in which the gas to feed the burner (20) is advantageously methane.

4 - Apparatus (18-118) as claimed in any claim hereinbefore, in which the outlet (27) to discharge the products of combustion is connected to a cooling unit (36) to cool the products of combustion.

5 - Apparatus (18-118) as claimed in any claim hereinbefore, in which the products of combustion are cooled with the water used to fill the dyeing apparatus (18-118).

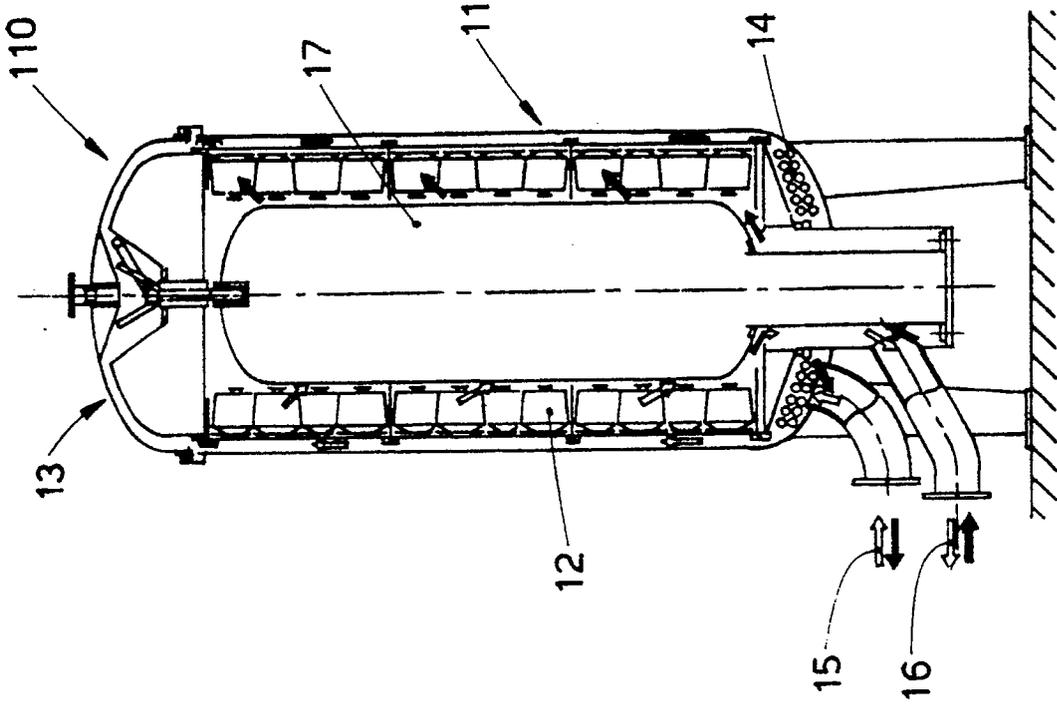


fig.2

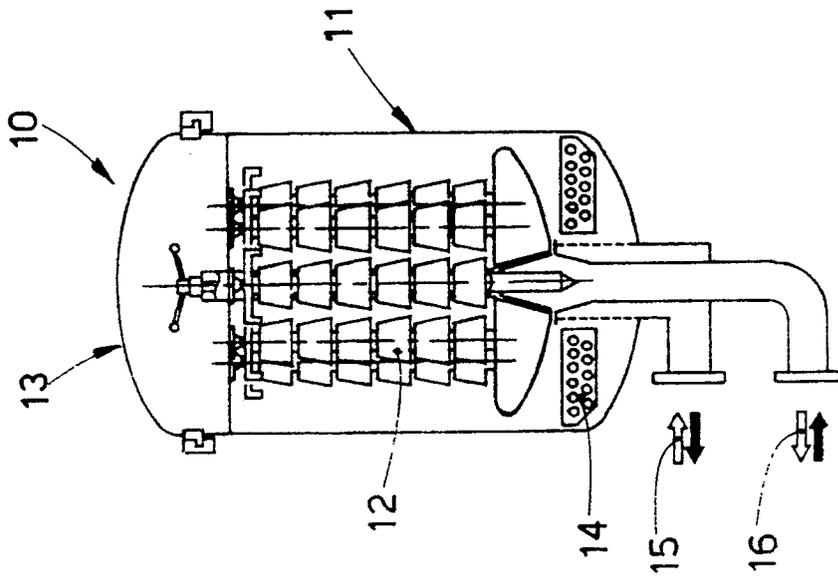


fig.1

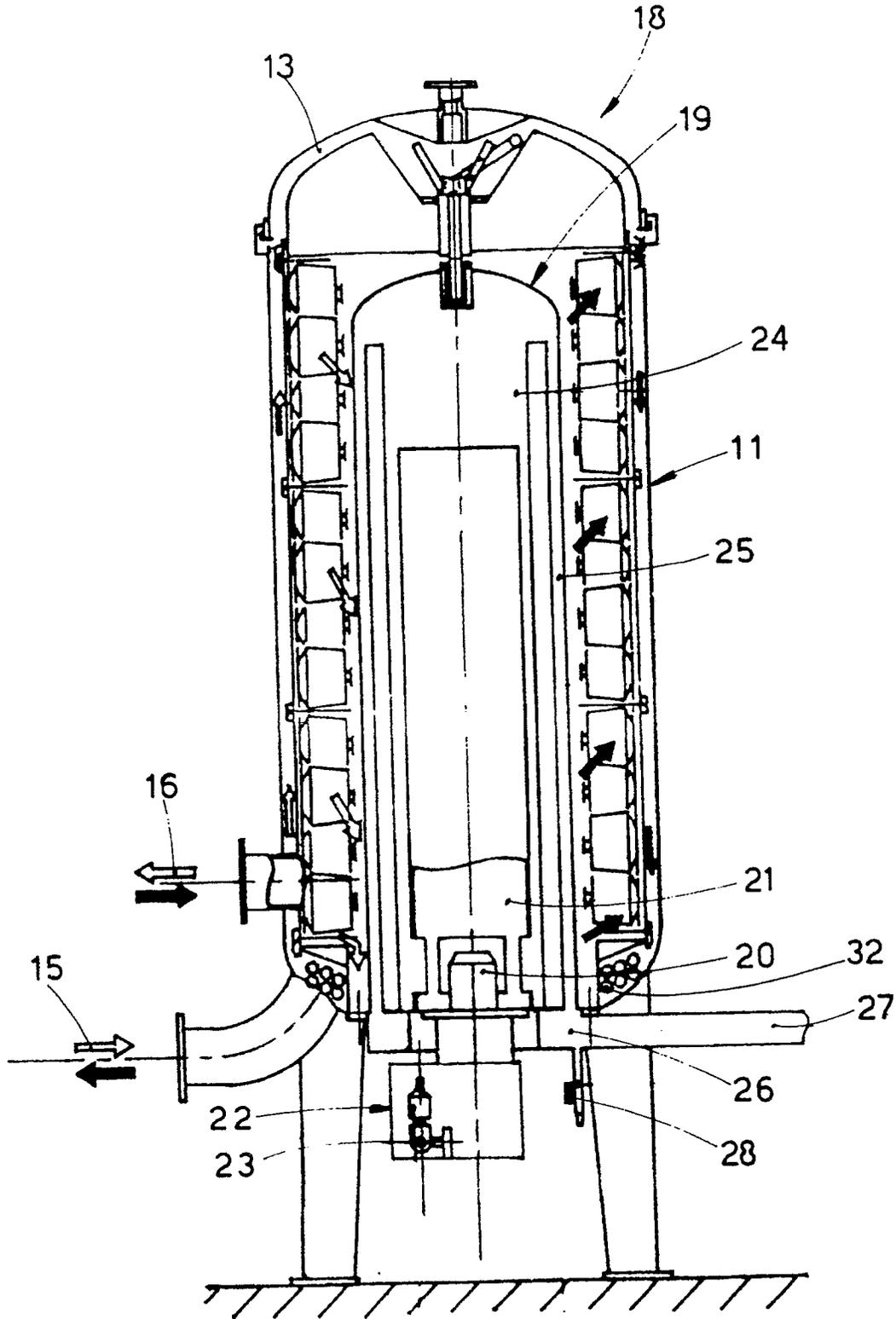


fig.3

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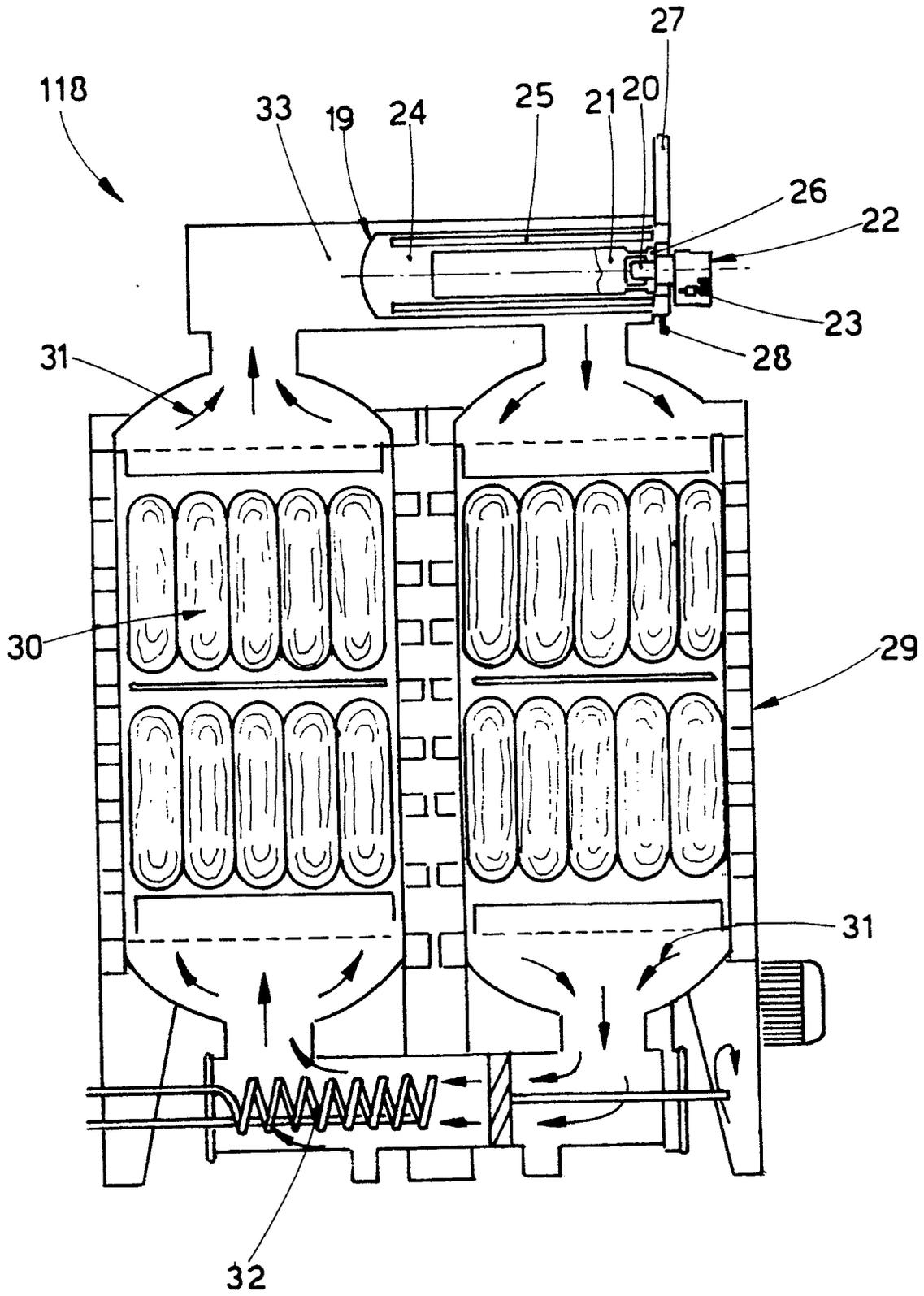


fig. 4

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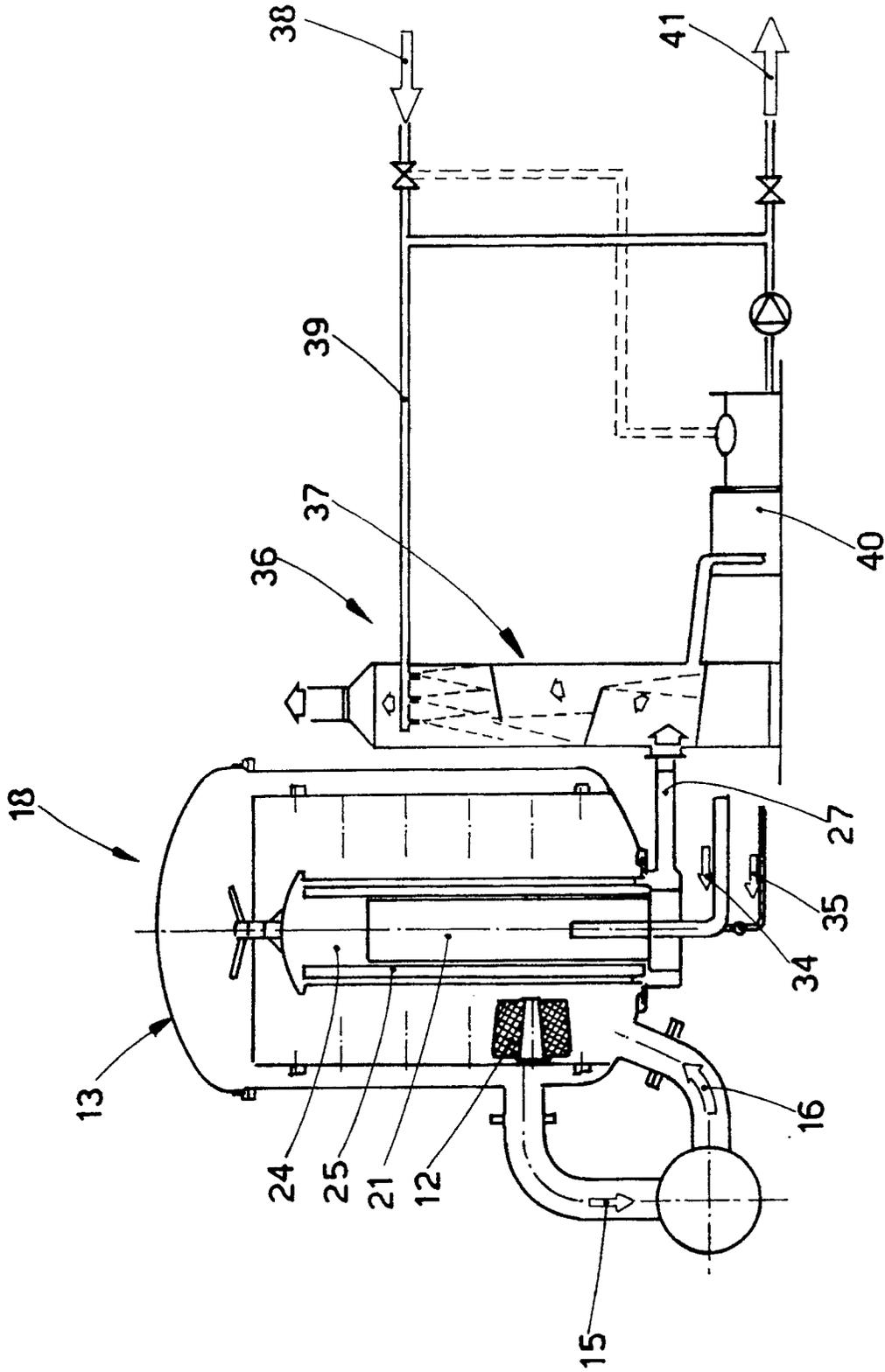


fig.5

*Alberto De Rosa*



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-9 759 02 (BONCOMPAIN) * the whole document * - - -	1-3,5	D 06 B 23/22 D 06 B 5/16
X	FR-A-1 003 780 (VAUVILLIER) * the whole document * - - -	1	
A	EP-A-0 036 690 (RONCHI) * abstract; figure 1 * - - -	1	
A	FR-A-2 253 865 (THIES) - - - - -		
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		28 February 91	PETIT J.P.
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X: particularly relevant if taken alone  Y: particularly relevant if combined with another document of the same category  A: technological background  O: non-written disclosure  P: intermediate document  T: theory or principle underlying the invention</p> <p>E: earlier patent document, but published on, or after the filing date  D: document cited in the application  L: document cited for other reasons  .....  &amp;: member of the same patent family, corresponding document</p>			
			<p>TECHNICAL FIELDS SEARCHED (Int. Cl.5)</p> <p>D 06 B</p>