United States Patent [19]

Nielsen

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[54] **APPARATUS FOR THE TREATMENT OF TEXTILES WITH LIQUID**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **68/15;** 68/188; 68/189

[51] **Int. Cl.²** **D06B 5/20**

[58] **Field of Search** 68/15, 189, 184, 187, 188; 134/154, 182, 183, 191, 198

[56] **References Cited**

UNITED STATES PATENTS

2,577,727	12/1951	Abbott	68/189
3,093,991	6/1963	Scharfenberger	68/188
3,727,436	4/1973	Vinas	68/189

FOREIGN PATENTS OR APPLICATIONS

1,363,047	4/1964	France	68/189
774,481	9/1934	France	68/188

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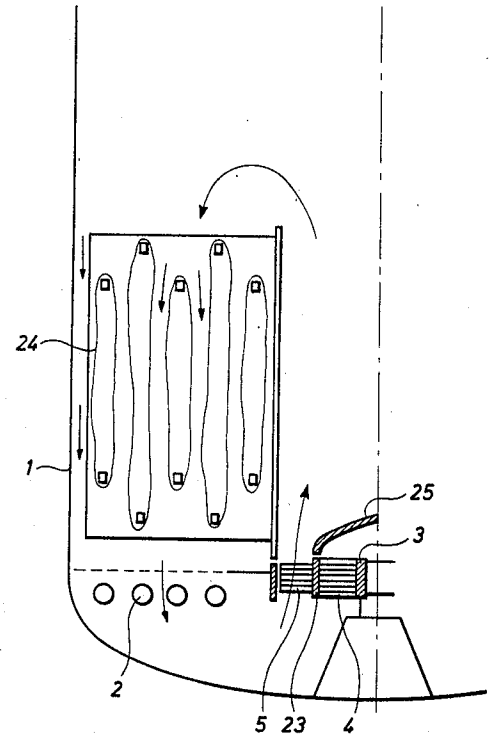
[57] **ABSTRACT**

An apparatus for liquid treatment of textile material having means for creating two differently directed flows of treating liquid through the container in which the textile material is placed on a replaceable insert.

3 Claims, 7 Drawing Figures



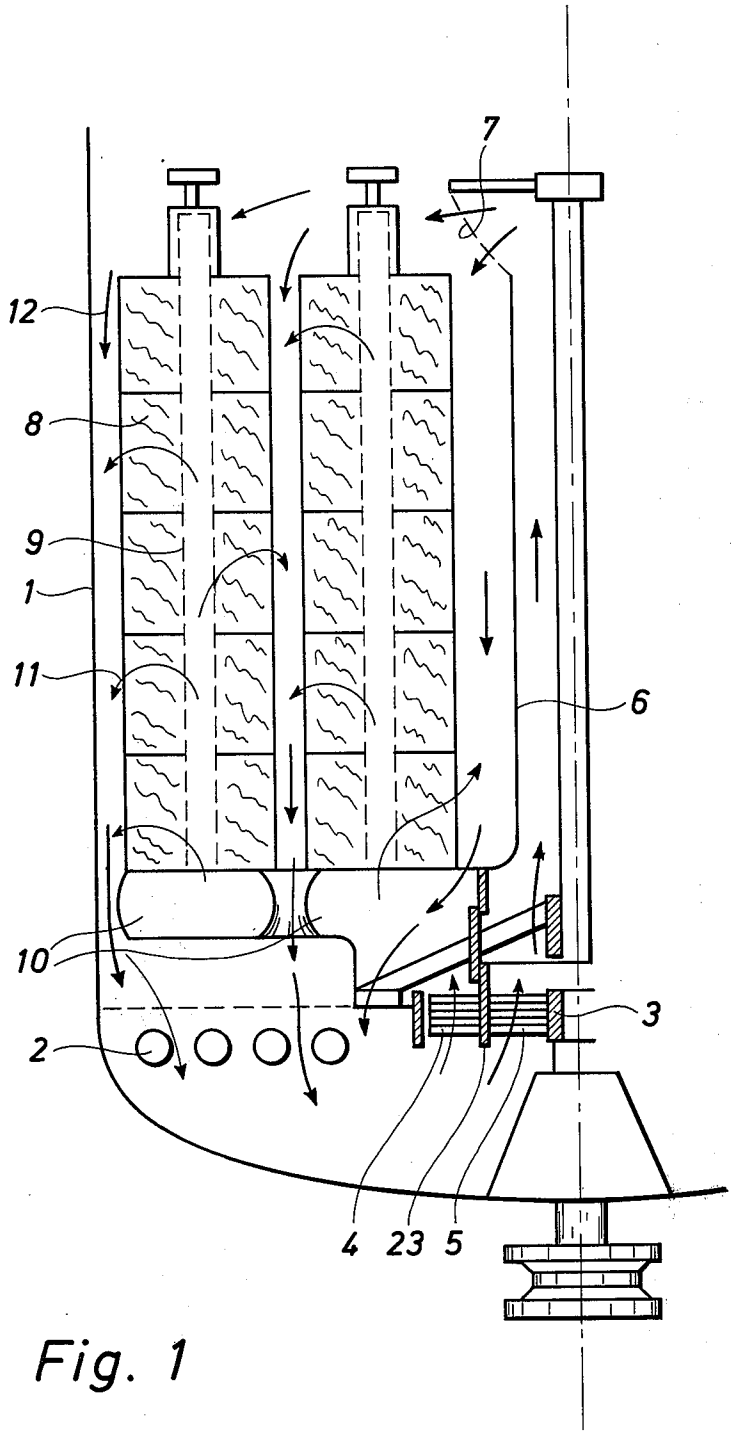


Fig. 1

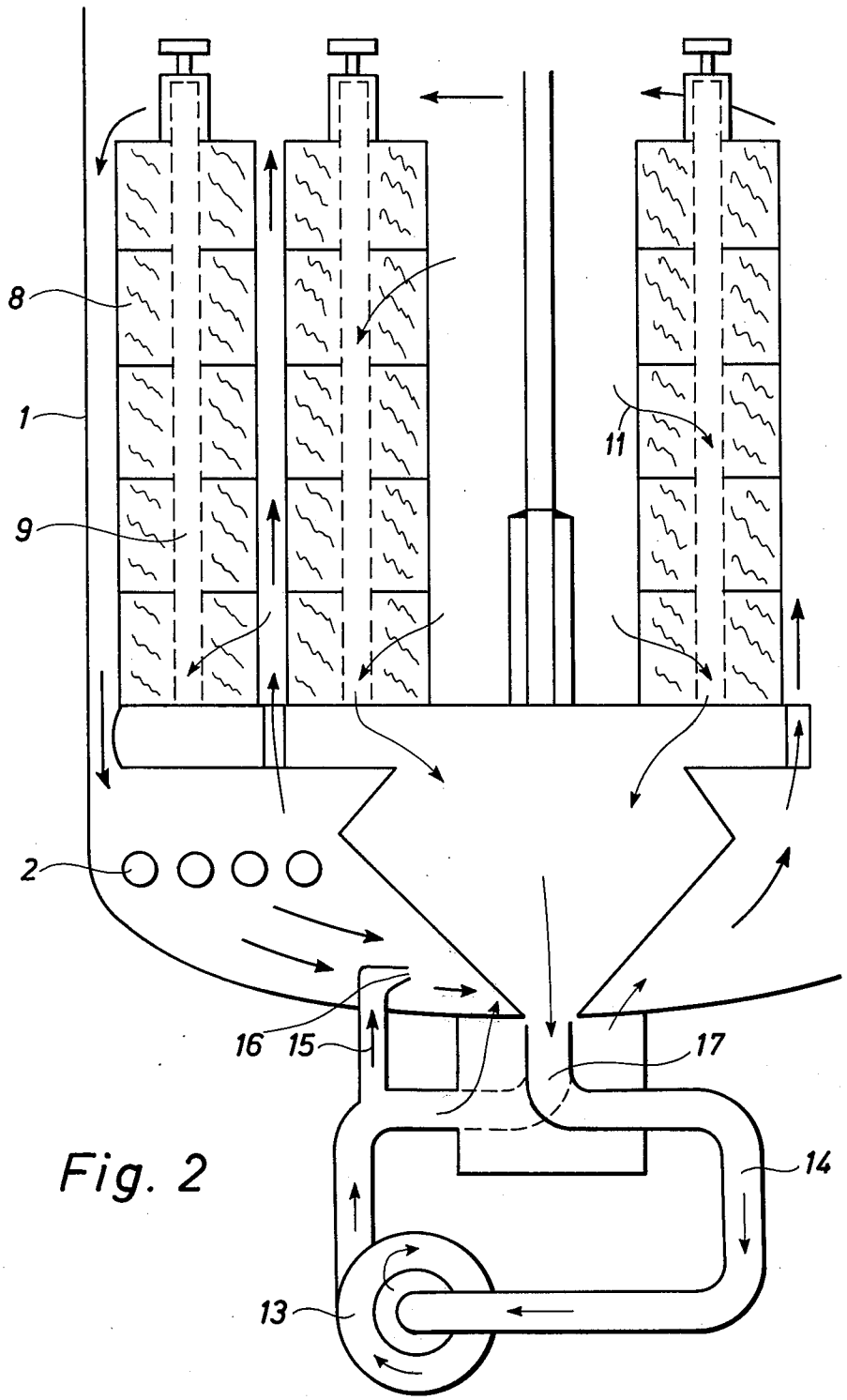


Fig. 2

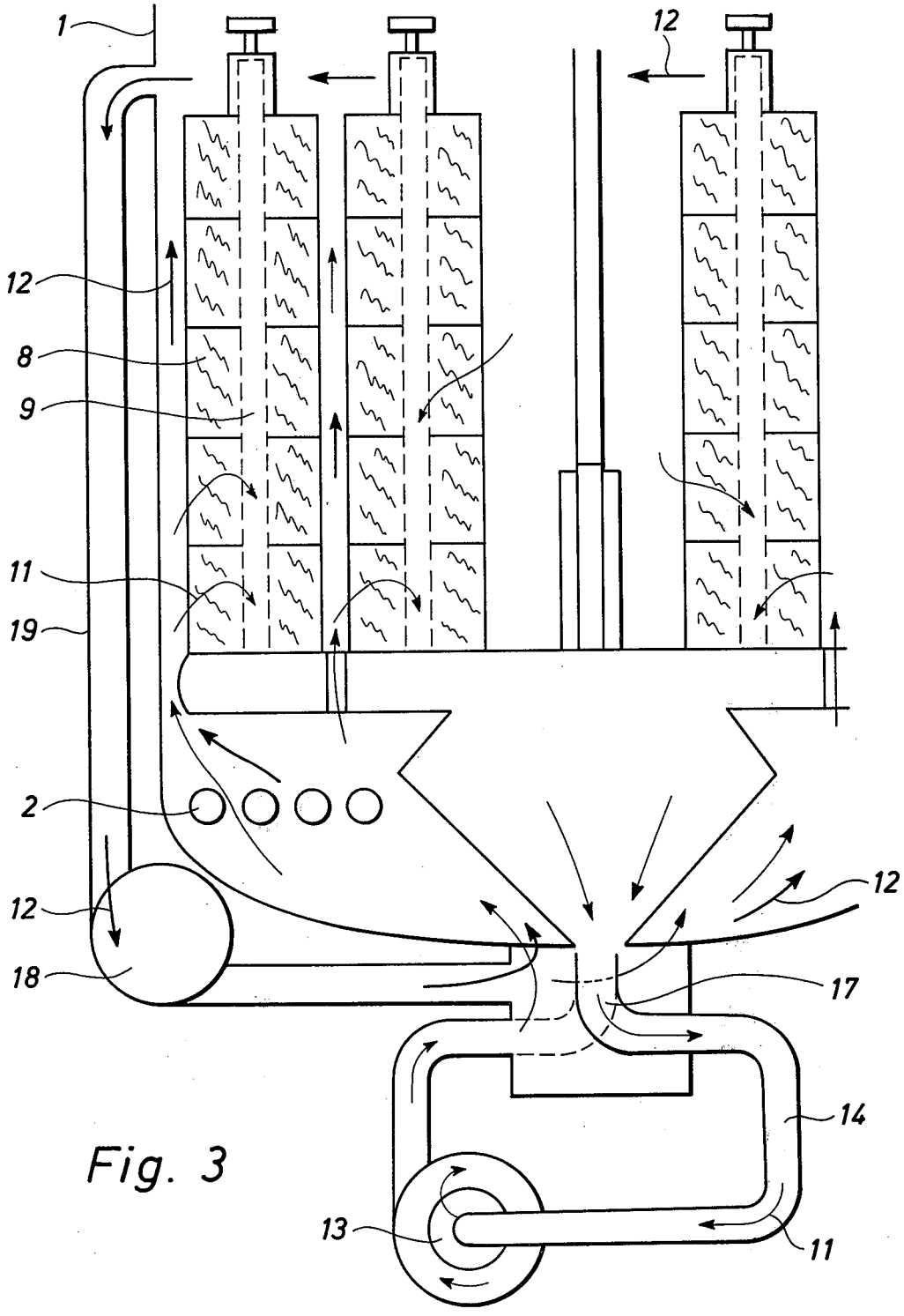


Fig. 3

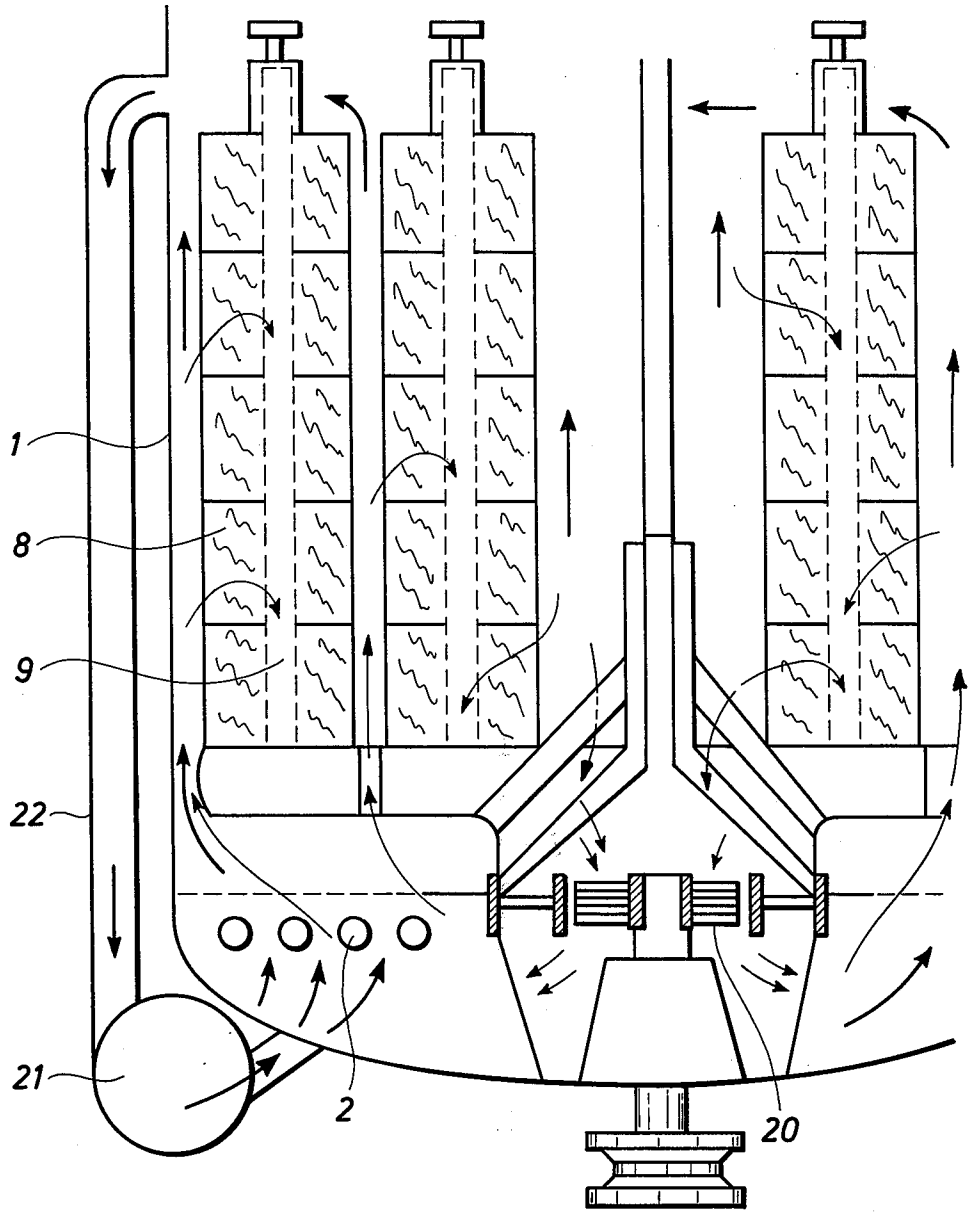


Fig. 4

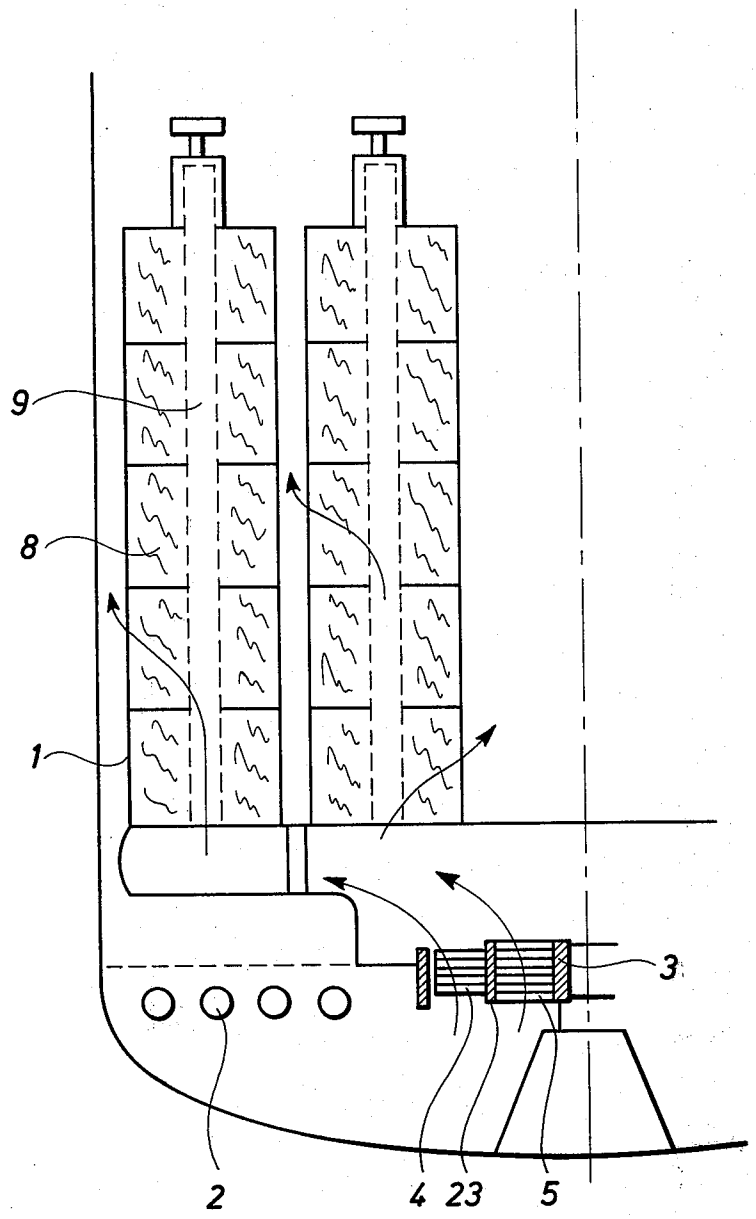


Fig. 5

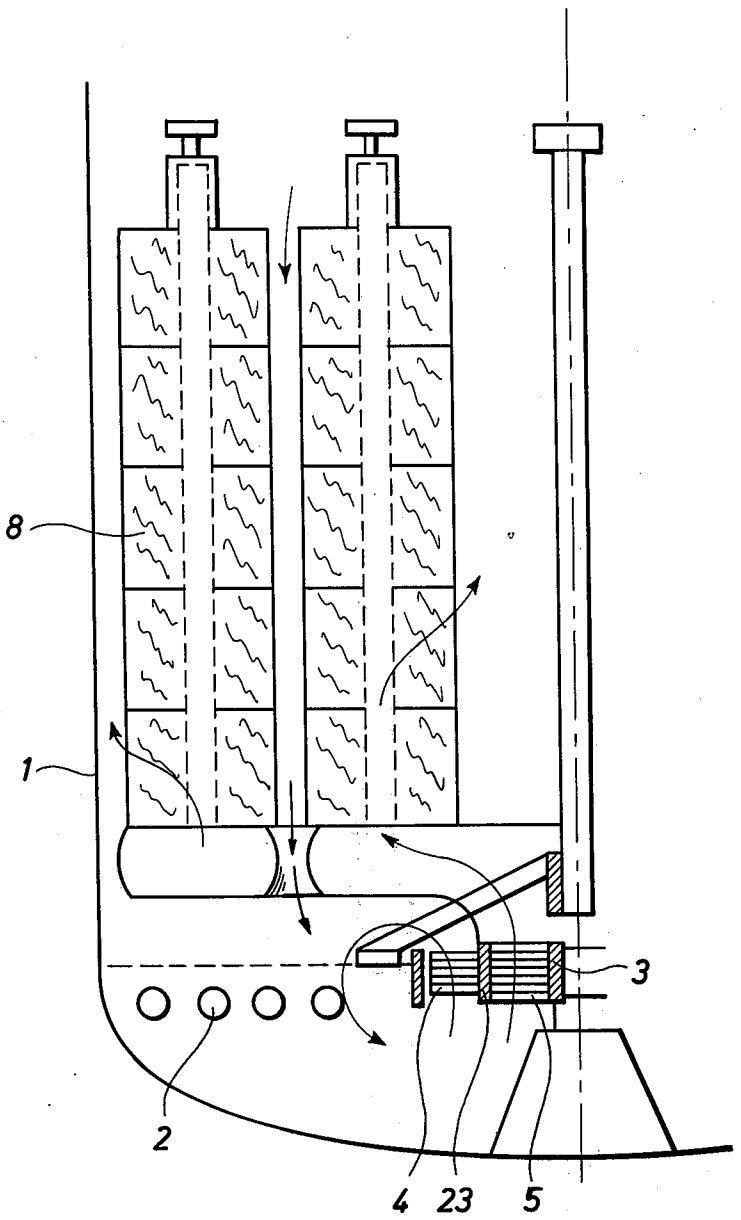


Fig. 6

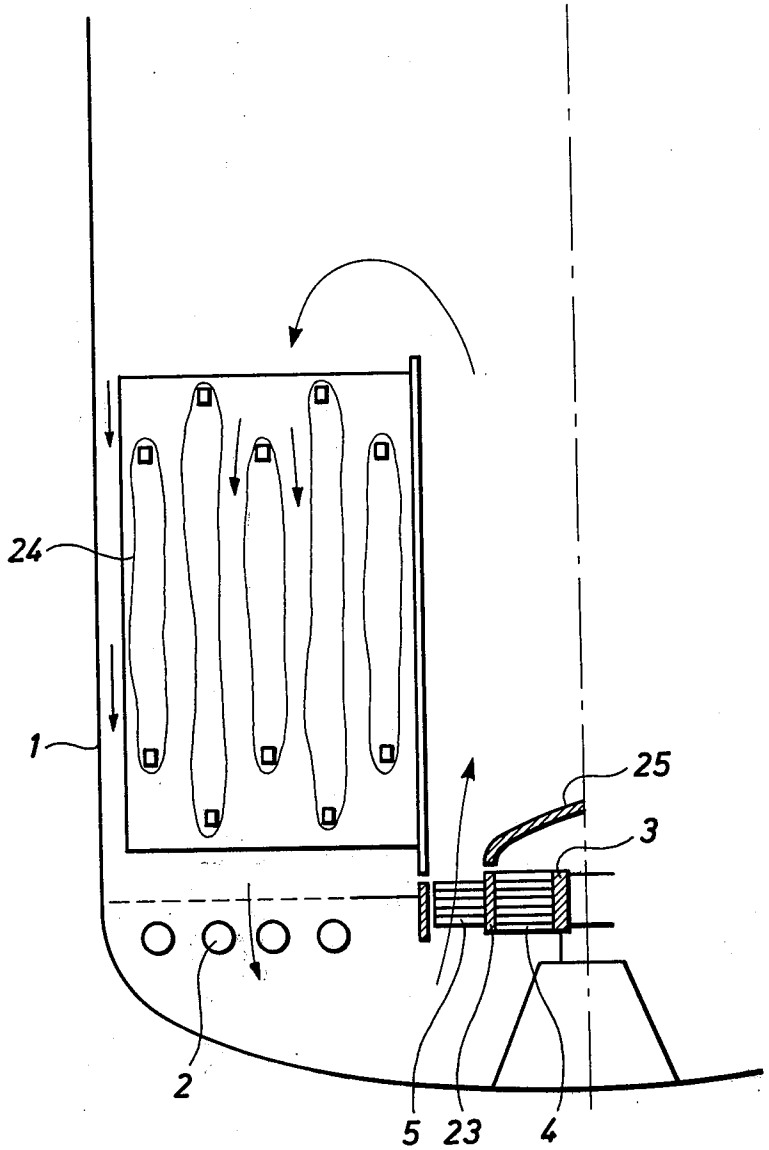


Fig. 7

APPARATUS FOR THE TREATMENT OF TEXTILES WITH LIQUID

The present invention relates to an apparatus for the treatment of textiles with liquid, the said apparatus consisting of a container for the liquid, a replaceable insert, on which the textile material is arranged in its loose or wound state, means for heating the liquid and means for circulating the treatment liquid through the textile material.

Apparatus of the aforesaid kind are used for liquid treatment, more particularly dyeing and bleaching of textiles at any stage in the processing of the textile material, from the loose unspun textile filament material via yarn to the finished textiles. The apparatus are normally of stainless steel intended for processing at temperatures up to 140°C and therefore adapted to resist inside pressures of up to 5 atmospheres. They are therefore expensive, and so it will be advantageous if one and the same apparatus can be used for liquid treatment of all kinds of textiles, that is, textile materials carried on inserts of widely different kind and textiles requiring widely different quantities and velocities of treatment liquid.

The yarn to be treated may, for example, be in the form of skeins which offer little resistance to the flow of the liquid, but are unable to stand up to a great velocity of flow since this may involve felting of the yarn. The treatment may also involve yarn wound in balls having a low resistance to flow, but which have to be treated at a great velocity of flow, that is a maximum quantity of dyestuff solution with the liquid flowing in the same direction during the whole treatment. Furthermore, the treatment may involve textile material wound in balls offering more or less resistance to the flow and requiring constantly alternating direction of flow.

In the lastmentioned case the problem of the known apparatus is to obtain a quick treatment, which to some measure is due to the fact that the rate at which the chemicals contained in the treatment liquid, usually dyestuffs, are picked up by the material is primarily regulated by the temperature, the treatment being started at a low temperature and finished after a heating programme at an essentially higher temperature. The rate of heating used must always be so low that the chemicals are uniformly picked up by the material. The rate at which the temperature may be raised from initial temperature to finishing temperature is determined in practice by the conversion of the bath and existing temperature differences of the treatment liquid and the textile material, the conversion of the bath being defined as:

Circulation in liters per minute Total contents in liters of the apparatus

The permissible temperature differences vary from about 0.2°C to 1°C dependent upon the nature of the textile material and the nature of the chemicals. A universally applicable apparatus for treating textile materials with a liquid has therefore to ensure that no temperature differences exceeding 0.2°C occur at the rates at which heating takes place.

If the bath is converted twice per minute and the heating takes place at 1°C per minute, the average temperature difference in the apparatus will be 0.5°C at an ideal distribution of the treatment liquid. Under actual conditions the temperature differences in the apparatus

will be highly varying. Thus, the temperature difference in the textile material closer to the heating means will, if anything, be equal to nil, whereas the temperature difference in the material remote from the heating means may be more than 1°C. If the rate of heating is doubled while the bath conversion is kept constant all temperature differences will also be doubled. It has therefore so far been impossible to reduce the time of treatment with such apparatus solely by increasing the rate of heating. It is known to reduce the time of treatment, however, by increasing both the bath conversion and the rate of heating; in fact, if the conversion of the bath is doubled, for example, the temperature differences will be reduced by one half, and it will thereby be possible to increase the rate of heating.

There are, however, limits to the amount by which the time of treatment can be reduced by means of the known apparatus if the textile material cannot stand up to an intense penetrating flow of treatment liquid, and it is furthermore comparatively too costly to increase the bath conversion, both because a doubling of such conversion requires a quadruple of the power consumption for the means circulating the treatment liquid, quite apart from the fact that it is impossible in apparatus of the kind involved to provide bearings of sufficient strength to carry very powerful circulating means.

There is consequently a need for apparatus for liquid treatment capable of giving a quicker treatment of textile materials than the existing apparatus and satisfying the requirement that the temperature differences in the apparatus must not exceed the aforesaid low values.

This is accomplished by the apparatus according to the invention which is furthermore universally applicable for all the aforesaid types of liquid treatment. An essential feature of the apparatus according to the invention is that it has means adapted to produce two differently directed flows of the treatment liquid.

As a result, one flow may in usual manner be directed as a primary flow through the textile material, whereas the other flow may be mixed as a secondary flow with the primary flow in the space outside the textile material, which may be effected without any essential increase in power consumption since the secondary flow need not overcome the resistance constituted by the textile material, and the result is a reduction of the temperature difference in the apparatus to a fraction of the temperature differences occurring in similar apparatus in which the treatment liquid flows in only one direction. The two differently directed flows of treatment liquid may further be united or directed in various manners as two separate flows, dependent on the kind of insert placed in the container. In other words, the alterations in the mode of operation of the apparatus necessitated by different textile materials may be effected by the use of different inserts. These may differ dependent on the nature of the textile materials, and may therefore without difficulty be formed in such manner that they either unite the liquid flows, keep them separated in two flows or deflect one of them so that it is mixed with the liquid in the container in such manner that it acts as if it were blanked off.

An essential feature of one embodiment of the apparatus according to the invention is that the means for producing two differently directed flows of treatment liquid are two different circulating members. One of the said members may, for example, be the usual circu-

lating pump of the apparatus, and the other member may be an extra pump which circulates the liquid into the apparatus at another point of the container. This is a simple embodiment which may be provided by fitting known apparatus with an extra pump which through a pipe withdraws the treatment liquid from or introduces it into the container at another point than the existing pump.

An essential feature of a variant of this embodiment of the apparatus according to the invention is that one circulating member is a propeller pump provided at the bottom of the container, whereas the other circulating member is a pump outside the container. In another modification the circulating members are two pumps arranged outside the container.

Another simple embodiment of the apparatus according to the invention has the advantage that it requires only a single circulating member, and the essential feature of the said embodiment is that the circulating member is a pump which is arranged outside the container and by means of a pipe system divides the liquid into two flows, one of these being introduced into the liquid chamber of the container through a nozzle-like member which causes a great velocity of flow.

A very advantageous embodiment of the apparatus according to the invention is, however, available when the means for producing two differently directed flows of treatment liquid consist of a propeller pump provided inside the container and having two blade rims. This is a very simple embodiment of the apparatus requiring no modification of the existing apparatus other than replacement of the blade rim and the use of an insert with means directing the flows produced by the blade rims into different directions.

Apparatus of the type involved here have usually a vertical container for the treatment liquid with the means for circulating the said liquid arranged in the bottom part of the container or outside same, but fundamentally there is nothing preventing the apparatus from having a horizontal container, which, for example, is often the case when the textile material processed is a web wound into a roll.

A typical apparatus is, however, one having a vertical container, in which the textile material is arranged on an insert which, for example, may have horizontal bars for the suspension of skeins of yarn or be provided with vertical distributing means that may be perforated tubes around which the textile material is arranged either with or without cases, or the said distributing means may be sectional irons which requires that the textile material is wound on cases.

The invention is disclosed in more detail in connection with such an apparatus which has a vertical container.

FIGS. 1–7 show parts of the various embodiments of an apparatus according to the invention, viewed in corresponding longitudinal, vertical sections.

The apparatus shown in FIG. 1 is very suitable for quick dyeing of textile materials of the kind arranged on vertical distributing means and requiring continual alteration of the liquid flow through the textile material.

1 is a vertical container having at its bottom end heating means 2 and means 3 for circulating the treatment liquid. The said means 3 consist of a double propeller with an outer blade rim 4 and an inner blade rim 5, separated by a ring 23. A central pipe 6 is provided on the insert in such manner as to keep the amounts of liquid over the blade rims 4 and 5 separated, providing sealing against the ring 23 by means of an annular member. At its upper end the pipe 6 ends in a distributor 7. Around the central pipe 6 the textile material 8 is arranged on perforated distributor pipes 9 which communicate at their lower end with distributor chambers 10. At one direction of rotation of the propeller the liquid flow is as indicated by the arrows, the thin arrows 11 showing the primary flow from the outer rim of blades 4 passing through the textile material and the thick arrows 12 showing the secondary flow from the inner rim of blades 5 which bypasses the textile material and is mixed with the primary flow in the spaces between the textile material and between the container 1 and the central tube 6. At reversed rotational direction of the propeller the direction of the flow is of course opposite to that of the arrows, and the two flows are then mixed, substantially at the bottom of the container near the heating means 2.

In an apparatus of the kind disclosed normally about one-fourth of the total amount of treatment liquid will be located in the spaces between the textile material and about one-fourth in the heating space at the bottom of the container, whereas only about one half is located in that part of the volume of the container which is occupied by the textile material. Owing to the large amount of liquid present outside the textile material and its highly varying velocity of flow, undesired temperature differences arise. However, in the apparatus according to the invention this drawback is avoided since it is possible with suitable rates of the primary flow and the secondary flow, obtained, for example, by an adequate selection of the form of the blades of the two blade rims 4 and 5, to reduce the temperature differences to a fraction of those occuring in an apparatus having only a primary flow of treatment liquid.

If, for example, the bath is converted twice every minute and the rate of heating is 1°C a minute, the temperature differences in an apparatus with primary flow only will be at least 1°C as previously referred to. In an apparatus according to the invention there may, for example, be a secondary flow of the same rate as the primary flow, that is, the total bath being converted twice. In this apparatus the conversion of the liquid outside the textile material will be $2 \times 2 = 4$ times per minute. The maximum temperature difference in the liquid outside the textile material will then be

$$\Delta t = \frac{\text{Temperature rise in °C per minute}}{(\text{primary} + \text{secondary}) \text{ conversion of bath}} = \frac{1°C}{(2+4)} = 0.167°C$$

or less than one-sixth of what it is in known apparatus. If the conversion of bath owing to a great resistance to the flow in the textile material should fall to, say, 1, the secondary flow will remain constant, and the maximum temperature difference will be kept at almost the same low level, that is

$$t = \frac{1°C}{(1+4)} = 0.2°C$$

In the embodiments illustrated in FIGS. 2–4 the same effect is obtained. In FIG. 2, 1 denotes a vertical container, 2 heating means and 8 the textile material arranged on distributor pipes 9.

The means for producing two differently directed flows of the treatment liquid are in this case constituted partly by a pump 13 mounted outside the container 1 and sending through a pipe system 14 a primary flow of liquid through the textile material in the direction of the thin arrows 11, partly a branch pipe 15 leading off the pipe system 14 and sending a part of the liquid flow into the bottom part of the container through a narrowed opening 16 which owing to the jet effect produces a secondary flow of liquid in the direction of the thick arrows 12. The direction of the flow is in this case indicated as passing from outside through the textile material 8. The flow is reversed by a swan neck 17 in the pipe system 14 being turned, by which only the primary flow is reversed, whereas the secondary flow keeps its direction. This embodiment is very simple and economising since a substantial mixing of the primary flow and the secondary flow is obtained by means of a single pump owing to the increased higher velocity of flow outside the opening 16.

In the embodiment shown in FIG. 3, 1 is a vertical container, 2 heating means and 8 the textile material arranged on distributer pipes 9. The means for producing two differently directed flows of the treatment liquid consist in this case of a pump 13 mounted outside the container, the said pump sending a primary fb w through the textile material via a pipe system 14 provided with a pivotable swan neck 17, either as indicated by the thin arrows 11 from outside through the textile material or, when the swan neck is turned into the position indicated by dotted lines, in the opposite direction, and a pump 18 which through an outer pipe 19 sends a flow in the direction indicated by the thick arrows 12 from the top of the container to its bottom.

In the embodiment shown in FIG. 4, 1 is a vertical container, 2 heating means and 8 the textile material arrranged on distributer pipes 9. The means for producing two differently directed flows of the treatment liquid consist of a propeller pump 20 provided in the bottom end of the container 1 and producing a primary flow, and a pump 21 which circulates the treatment liquid as a secondary flow through an outer pipe 22. The primary flow is indicated by means of thin arrows 11 and the secondary flow by thick arrows 12.

FIG. 5 shows the same apparatus as FIG. 1, used for dyeing balls of yarn which offer but slight resistance to the liquid flow and which are treated by the maximum amount of dyestuff liquor from inside out through the balls as indicated by the arrows, or in the opposite direction. The insert has therefore no tubular member for directing the flows from the two blade rims 4 and 5 in different directions, but the said flows are united into a single powerful flow so that the apparatus for the purpose illustrated may be said to operate as the known apparatus having a propeller pump with a single rim of blades.

FIG. 6 shows the same apparatus as FIG. 1, used for dyeing yarn wound in bobbins offering some resistance to a flow, but not able to stand up to any powerful flow of liquid. The insert used is therefore formed in such manner that only the liquid flow from the inner rim of blades 5 is passed through the yarn, either from inside or from outside through the bobbins, whereas the liquid flow from the outer rim of blades 4 is deflected and commences its separate circulation in the bottom part of the container or is blanked off.

FIG. 7 shows the same apparatus as FIG. 1, used for dyeing yarn in skeins. The said skeins 24 offer but a slight counterpressure, but cannot stand up to such a great amount of dyestuff liquor as loosely wound bobbins, and they are therefore arranged on an insert which is formed at its lower end with a circular shield 25 which blanks off the inner rim of blades 4 so that only the flow from the outer rim of blades 5 is circulated up through the insert. The flow from the inner rim of blades 4 may, for example, be passed through the hollow shaft of the propeller so as to produce a circulation confined to the bottom part of the container, without the liquid circulation through the skeins being impaired, or it may be caused to circulate in another manner.

In case the means for producing two differently directed flows of the treatment liquid are two different circulating means, it is evident that the volume of the two flows may be regulated through the circulating means, thus adapting them to suit the requirements of the textile material. But also in the case where there is only a single circulating means, the same result is obtainable. If the circulating means consists of a propeller with two rims of blades, the volume of the two flows in relation to each other and partly their direction may be regulated through the number and position of the blades or vanes. The two flows inside the apparatus are controlled by means of the insert which, as shown in FIG. 1, may be provided with an annular member effecting a sealing between the two rims of blades, or the said member may only be provided with a pipe of desired diameter which is passed down towards the propeller and passes the flow from same into two different directions without making such a sharp division of the flows as in the case illustrated in FIG. 1.

I claim:

1. Apparatus for treating textile material with heated treatment liquid, comprising:
- a container;
- a replaceable insert received in the container and having means thereon for supporting the textile material to be treated.
- a reservoir for treating liquid;
- means for heating the treating liquid;
- pump means for circulating the heated treating liquid from the reservoir to the container for contact with the textile material;
- divider means between the pumping means and container which may be disposed to divide the heated treating liquid into two differently directed flows;
- the pump means being constituted by a propeller-type pump having a propeller means provided with two distinct sets of rotated blades having said divider means disposed between them.

2. The apparatus of claim 1 the divider means further including removable shield means removably covering one of said sets of rotated blades for selectively preventing the heated treating liquid flow otherwise directed therethrough.

3. The apparatus of claim 2 wherein the removable shield means of said divider means is positioned to direct one of the flows to the textile material in the container and to direct the other of the flows to the reservoir.

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