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(54) **Textile washing method and apparatus.**

(57) Fabric (F) is washed in open-width and continuous manner (10) and then is subjected to a mechanical milling operation (18) while in a reduced width configuration. The fabric is then opened to its full width again to remove any creasing resulting from the milling operation and is preferably subjected to a second washing operation (11,12).

This invention relates to a method and apparatus for washing textile webs in open-width.

The term "washing" used herein and in the claims is to be construed as including scouring and rinsing.

Some fabrics are susceptible to creasing and it is for this reason that they are washed in open-width rather than being washed in rope configuration and consequently these fabrics are not subjected to any working or milling action to increase the bulk or body thereof. Open-width washing therefore tends to be restricted to fabrics which do not require milling but the majority of wool fabrics which can readily be washed in open-width do require to be milled or worked.

It is an object of the present invention to provide an open-width fabric washing method and apparatus which provides this milling facility when required for a fabric.

According to a first aspect of the present invention there is provided a method of washing fabric in open-width which includes the steps of reducing the fabric width and, while in such reduced-width configuration, subjecting the fabric to a mechanical milling action whereby the bulk of the fabric is increased.

The term "milling" used herein and in the claims is to be construed as meaning any working action whereby adjacent contacting portions of the fabric are caused to be moved relative to each other to stimulate increase in fabric bulk.

Preferably, the fabric is subjected, while being mechanically milled, to a strong soaping action.

The terms "soap" and "saponaceous" used herein and in the claims are to be construed as including synthetic or natural milling additives, for example, synthetic detergents.

The fabric may alternatively be subjected to the strong soaping action while still in the open-width configuration and prior to mechanical milling.

Preferably, the fabric is mechanically milled in a compartment wherein it is subjected to the action of reciprocating pushing means, which causes relative rubbing movement between adjacent portions of fabric, the pushing means and the walls of the compartment thereby to achieve bulking of the fabric.

The mechanical milling may alternatively be effected by other mechanical working elements such, for example, as rollers, paddles, flails or vibratory devices.

Where rollers are employed to apply the mechanical milling action the method includes the step of reducing the width of the fabric to form a rope configuration.

Preferably the method comprises the steps of re-opening the milled fabric to open-width configuration and thereafter subjecting it to at least a final rinsing action, but preferably a washing or lathering action to remove retained soap followed by a final rinsing action.

The fabric, after being subjected to the mechanical milling action may pass through a squeezing nip or suction means to remove saponaceous liquid therefrom.

Preferably the method includes the step of returning such liquid to the mechanical milling compartment.

Preferably the method includes the step of controlling the rate of extraction of the fabric from the mechanical milling stage to ensure that neither too much or too little fabric is present in the milling compartment.

In the former condition there is risk of damage to the mechanical milling elements and compartment and in the latter condition little or no milling of the fabric would occur.

The mechanical milling of the reduced-width fabric may be effected in two or more stages with possibly intervening soaping stages between adjacent mechanical milling stages.

The washing method may be multi-stage in nature with a mechanical milling stage between adjacent washing stages. In this instance, the fabric may be constrained to move from open-width to reduced-width and back to open-width more than once, or may move directly, in reduced-width configuration, from one milling stage to a following milling stage.

The open-width washing method is preferably substantially as disclosed in published European Patent No. 0259169 with the mechanical milling stage being preferably interposed between the first and second washing stage, or alternatively the second washing stage and final rinsing stage, or both.

Preferably the reduced-width fabric is caused to dwell by accumulation for a predetermined time in the mechanical milling stage to control the degree of milling to which the fabric is subjected and the consequent increase in fabric bulk.

In the milling stage, the degree of milling to which the fabric is subjected may alternatively or additionally be controlled by the mechanical forces to which the fabric is subjected.

These mechanical forces may be compressive and/or kinetic in nature.

According to a second aspect of the present invention there is provided apparatus for washing fabric in open-width which incorporates a mechanical milling apparatus into and through which the fabric is constrained to pass and which comprises a milling compartment of a width less than the open-width of the fabric, and kinetic means within the milling compartment for causing relative rubbing movement between adjacent portions of the fabric, the compartment and the kinetic means to increase the bulk of the fabric.

The kinetic milling means is preferably constituted by a reciprocable pushing member.

Preferably the kinetic milling means comprises

two opposed pairs of reciprocable pushing members or stocks defining therebetween a mechanical milling zone.

Preferably means for driving the pushing members or stocks of each pair simultaneously in opposite directions is provided.

The driving means may be arranged to move each pair of opposed pushing members simultaneously, in phase, in the same or opposite directions, or in any desired combination of directional movements, in phase or out of phase.

The milling compartment preferably comprises a trough or similar having a top cover defining in spaced relationship, a fabric inlet and a fabric outlet.

Preferably the cover is openable or removable to permit access to the milling zone and the pushing members or stocks.

Preferably, means is provided for delivering a saponaceous solution into the milling compartment.

Preferably, the delivery means supplies the saponaceous solution to the inlet end of the milling compartment, preferably at or through the fabric inlet in the cover.

Preferably, a squeeze nip or suction means is provided downstream of the milling compartment to remove saponaceous liquid from the milled fabric.

Preferably, means is provided to deliver such extracted saponaceous liquid into the milling compartment, preferably at the fabric inlet in the cover.

Alternatively, the fabric is conveyed through a saponaceous solution bath prior to entering the milling compartment.

The open-width washing apparatus is preferably substantially as disclosed in the aforesaid published European Patent Application with the mechanical milling apparatus disposed between two adjacent washing stages or a washing stage and rinsing stage.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic side elevation of an open-width washing apparatus incorporating a preferred form of mechanical milling apparatus according to the present invention; and

Fig. 2 is a perspective view of the mechanical milling apparatus of Fig. 1.

In Fig. 1 there is shown an open-width continuous washing apparatus comprising three identical stages 10, 11 and 12.

The apparatus is, for example, used for scouring and washing a continuous length of open-width, wool fabric indicated by the reference F.

Considering the open-width washing aspect only of the apparatus the fabric F is subjected in stage 10 to washing with a warm concentrated scouring liquor (a solution of warm water, soap and soda ash), in stage 11 to washing employing a warm less concentrated scouring liquor, and in stage 12 to rinsing solely

with warm water.

The constructional features of stages 10, 11 and 12 are identical and therefore only stage 10 will be described in detail.

The fabric F, in washing stage 10, is conveyed through three vertically-spaced, identical washing levels at each of which is provided a pair of sprays 13 for impregnating or soaking both sides of the fabric F with the scouring liquor (water in stage 12), a bowed expander bar 14 for maintaining the fabric in open-width and a suction tube 15 for pulling liquor through and out of the fabric F.

The fabric F, during its vertical movement, is constrained by the expander bars 14 and guide rollers 16 to follow vertically-spaced inclined, generally horizontal paths, down which the scouring liquid (or warm water) runs, the suction tubes 15 being disposed below these paths.

The extracted scouring liquor and accompanying air is subjected to separation and recirculation as is disclosed in the aforesaid published European Patent Application.

The configuration of the washing levels as shown and described ensures that there is a pool or stream of washing liquor on top of the fabric F as it passes over the bottom and the middle suction tubes 15 while the top suction tube 15 operates above the washing liquor supply level ensuring that when the fabric F leaves the top suction tube 15 the major proportion of dirt and other contaminants contained in the fabric F are removed and that the warm fabric F contains a residue of concentrated scouring liquor but with the liquor content of the fabric F being substantially reduced.

It is preferred that the retained liquor content of the fabric F be not more than approximately 50% of the dry weight of the fabric F.

Transport rollers for use in conveying the fabric F through the washing apparatus are indicated by the reference 17.

The continuous open-width washing apparatus as shown in Fig. 1, therefore, subjects the fabric F to washing and scouring with an extremely concentrated liquor at stage 10, washing with less concentrated scouring liquor at stage 11 and rinsing using only warm water at stage 12.

The present invention is concerned with adding to the open-width washing apparatus a facility for milling the fabric F in continuous form so that it is given increased bulk or body but without rope marking the fabric F as occurs with conventional batch milling machinery.

It is known to those skilled in the art that milling of fabric to increase the bulk thereof is best achieved if the fabric is not too wet, is warm, has a sufficiently high dry soap content and is subjected to mechanical forces sufficient to disturb the fibres of the fabric relative to each other.

The open-width fabric F leaving the top suction tube 15 of stage 10 is, as described above, not too wet and is warm.

To ensure that the fabric F is not too wet for the milling operation, liquor extraction is increased at the top suction tube 15 of washing stage 10 by providing two (or possibly more) rows of suction holes compared with the customary single row of holes. This increased liquor extraction can be achieved in any other suitable manner.

Milling of the open-width fabric F is achieved by locating between two washing stages a milling apparatus within which the fabric F is mechanically worked to give the desired increased body or bulk thereto.

In Fig. 1 there is shown between washing stages 10 and 11 a milling apparatus 18 in accordance with the invention.

The milling apparatus 18 comprises a trough 19 closed by a stationary fixed cover 20 which is removable or openable to permit access to the trough interior and which is fixed in position during the milling operation.

The cover 20 defines a fabric inlet 21 adjacent one end of the trough 19 and a fabric outlet 22 adjacent the other end.

Within the trough 19 are two opposed pairs of pushing members 23, 24 which define between them a milling zone 25.

The pushing members 23, 24 are caused to reciprocate to-and-fro by convenient drive means generally indicated at 26.

Each pushing member 23 and its respective opposed pushing member 24 can be reciprocated, in phase, in the same direction or opposite directions simultaneously or the reciprocating movements of the respective pairs 23, 24 or of all four can be out of synchronism.

The drive means 26, which may be of any convenient form, may, for example, comprise, for each pair of pushing members 23, 24, a respective crank shaft 27 coupled to its pushing members or stocks 23, 24 by connecting rods 28, the crank shaft 27 being drivingly interconnected by endless transmission belts or chains 29 driven, in turn, by a motor 30. Each pair of pushing members 23, 24 may alternatively have an independent drive to give phased or out-of-phase reciprocation as aforesaid.

A saponaceous liquid supply tank 31 (see Fig. 2) is disposed adjacent to the milling apparatus 18, which tank 31 incorporates a heater, and the saponaceous liquid (a soap and warm water solution) is delivered into the trough 19 by a supply pipe 32.

The saponaceous liquid is suitably pumped (see 31A) along the supply pipe 32 which delivers same out of bottom holes or apertures into the trough 19 via the fabric inlet 21, the pipe 32 returning to the supply tank 31 as shown (a simple ring circuit).

The saponaceous liquid is a strong soap solution and is supplied in such quantity that, unlike existing milling practice as hereinbefore mentioned, the fabric F in the milling zone 25 is thoroughly saturated with the saponaceous liquid so that has a substantially sloppy character or feel.

It is to be clearly understood, however, that the conventional "dry soap" method hereinbefore mentioned may alternatively be employed.

The strong soap referred to herein and in the claims for milling purposes may, for example, contain 2% to 20% dry weight of soap. A convenient range is considered to be between 6% and 10%.

The soaping of the fabric F leaving washing stage 10 for milling may alternatively be effected by passing the washed fabric through a soaping bath disposed between the washing stage 10 and the milling apparatus 18 and preferably between washing stage 10 and a width-reducing device 34 hereinafter described.

The width of the trough 19 is less than the fully open-width of the fabric F, say 40% of said fully open-width and therefore the width of the fabric F leaving the washing stage 10 requires, in accordance with this invention, to be restricted.

A fabric width restricting device 34 (see Fig. 2) is, therefore, provided between the washing stage 10 and the milling apparatus 18.

In this embodiment, the width restricting device 34 comprises a triangular frame, whereof the sides 34A are adjustable relative to the base 34B to vary the size of the enclosed triangular area and consequently the restricted width of the fabric F.

Other forms of width restricting device may be employed. For example, a ring or tube through which the fabric F passes, or a downwardly converging chute with containing side walls.

An expander bar or bars 35 together with opening guiders is provided between the milling apparatus 18 and the washing stage 11 to assist the fabric F in opening to its full width again after leaving the milling apparatus.

A driven squeezing nip 36, or suction means (not shown), may be provided upstream or downstream of the expander bar 35 to remove saponaceous liquid from the milled fabric F and such extracted liquid is returned into the milling apparatus 18 through the fabric inlet 21 by a pipe or duct 37 connected to a collection tray 37A or by any other convenient return device.

The driven nip 36, if provided, assists in pulling the milled fabric F out of the milling apparatus.

Alternatively the extracted saponaceous liquid may be returned to the supply tank 31.

The fabric F is thus washed and scoured in washing stage 10 in fully open-width form, is delivered, not too wet, in reduced width form into the milling apparatus 18 where it is soaked with warm saponaceous liquid and subjected to the milling or

working action of the reciprocating pushing members or stocks 23, 24 within the working zone 25, exits from the milling apparatus 18, possibly passing through the squeezing nip 36, to take up its full open-width configuration again before passing into washing stage 11, which may use simply warm water or warm less concentrated scouring liquor.

As a result of this invention fabrics which are normally run on batch machines in rope form to achieve a milling action with the risk of rope marks can be washed on a continuous machine in open-width, milled in reduced width where creasing not rope marking will occur, and then opened again to full width for further washing with consequent removal of any creasing, or substantially so.

The reduced width fabric may be milled or worked within a milling compartment such, for example, as 18 by other than reciprocating pushing members or stocks 23, 24. The milling members may, for example, be rollers, paddles, flails or vibratory devices.

If rollers are employed the fabric F will be reduced in width to a rope configuration.

It is desirable that the milling zone 25 contains at any one time neither too much or too little fabric possibly resulting in damage to the milling apparatus 18 or little or no milling action on the fabric, and consequently a sensing device may be associated with the driving motor or motors of the milling apparatus to measure the power output which will indicate the fabric content of the milling zone 25, which sensing device is also coupled to the drive for the transport rollers 17 of the washing stage 11 and the drive for the squeezing nip 36, if provided, to control the rate of removal of the fabric F from the milling zone.

Other sensing arrangements may be employed to detect the fabric content of the milling zone 25 and control the rate of extraction of the fabric F from the milling zone.

The degree of milling is controlled by fabric dwell time within the milling zone 25 and the reciprocable speed of the oppositely-acting pushing members 23, 24, and the quantity of fabric in the milling zone 25 which varies the pressure on pushing members 23, 24.

The milled fabric, now once again in open-width, passes into the washing stage 11 for lathering clean prior to its passage to rinsing stage 12.

To correct and remove marking of the fabric which may occur during milling, the fabric may be passed into a second milling stage before being passed in open-width to the washing (lathering) stage 11 with or without intervening widthwise opening of the fabric.

For the avoidance of doubt the present invention may be applied to open-width washing apparatus other than that described herein.

Claims

1. A method of washing fabric continuously in open-width which includes the steps of reducing the fabric width and, while in such reduced width configuration, subjecting the fabric to a mechanical milling action whereby the bulk of the fabric is increased.
2. A method as claimed in claim 1 comprising the step of washing the fabric in open-width prior and subsequent to subjecting it to the reduced width mechanical milling action.
3. A method as claimed in claim 1 or 2 comprising the step of subjecting the reduced width fabric, while being mechanically milled, to the action of a strong soaping solution, or the step of subjecting the fabric, while in open-width configuration and prior to width reduction and milling, to the action of strong soaping solution.
4. A method as claimed in any one of claims 1 to 3 in which the fabric is mechanically milled in a compartment wherein it is subjected to the action kinetic milling means, for example, reciprocating pushing means, which causes relative rubbing movement between adjacent portions of fabric, the kinetic milling means and the walls of the compartment thereby to achieve bulking of the fabric.
5. A method as claimed in claim 3 or 4 comprising the step of removing soap solution (saponaceous liquid) out of the milled fabric as it returns to, or has returned to, full open-width either by a squeezing action or a suction action.
6. Apparatus for continuously washing fabric in open-width which incorporates a mechanical milling apparatus into and through which the fabric is constrained to pass and which comprises a milling compartment of a width less than the open-width of the fabric, and kinetic means within the milling compartment for causing relative rubbing movement between adjacent portions of the fabric, the compartment and the kinetic means to increase the bulk of the fabric.
7. Apparatus as claimed in claim 6 in which the kinetic milling means comprises two opposed pairs of reciprocable pushing members or stocks defining therebetween a mechanical milling zone.
8. Apparatus as claimed in claim 6 or 7 in which means is provided for delivering a saponaceous solution into the milling compartment, preferably at a fabric inlet to the milling compartment.

9. Apparatus as claimed in any one of claims 6 to 8 comprising, upstream of the mechanical milling apparatus in terms of the direction of fabric movement a device for reducing the width of the washed fabric prior to its entry into the mechanical milling apparatus. 5
10. Apparatus as claimed in claim 8 or 9 in which a squeeze nip or suction means is provided downstream of the milling compartment to remove saponaceous liquid from the milled fabric. 10

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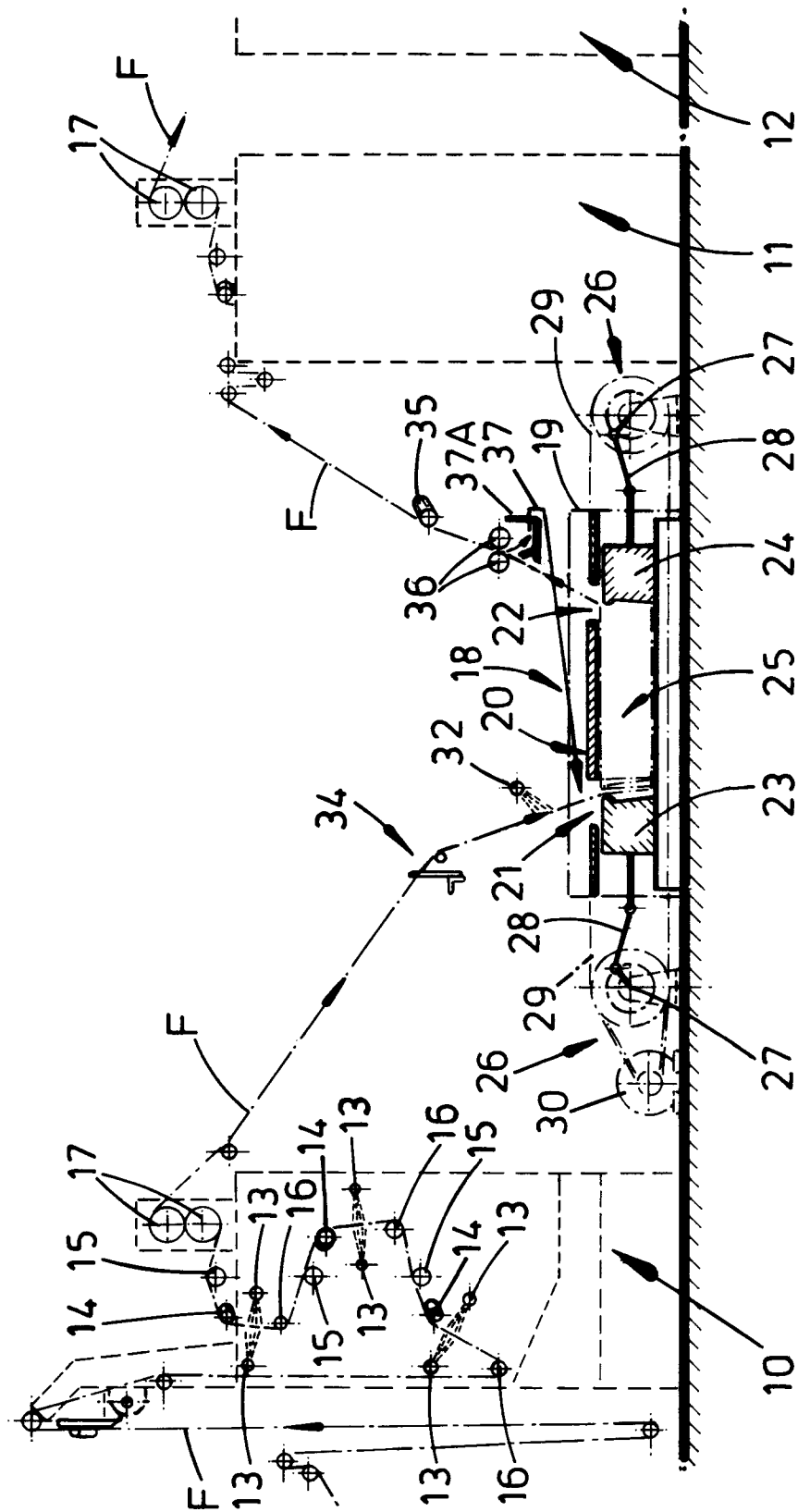
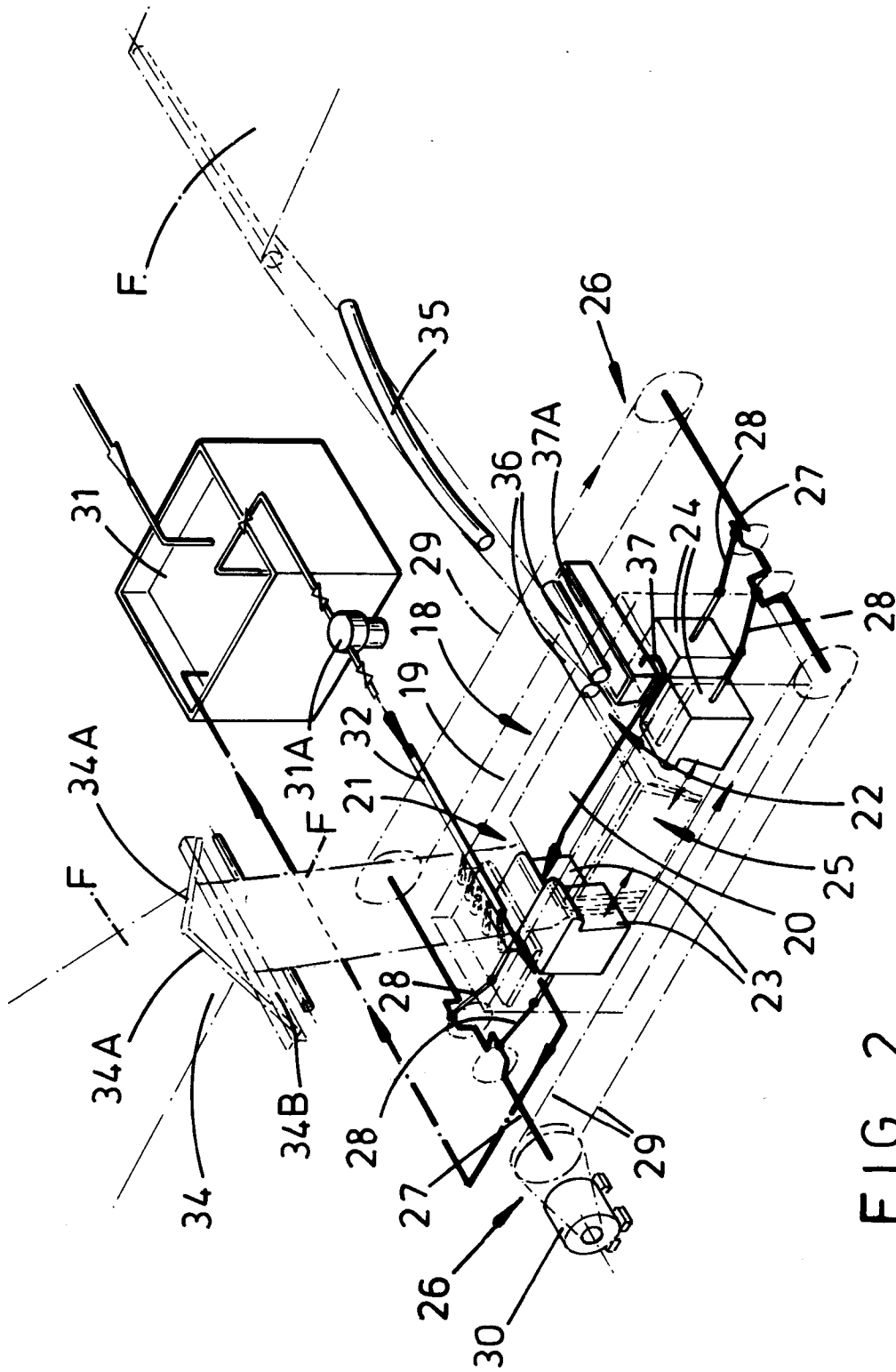


FIG. 1





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 6157

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)
Y	GB-A-2 017 776 (SHOZO IWATA) * the whole document *	1	D06C17/04
Y	DE-A-3 443 747 (AKZO) * the whole document *	1	
A	EP-A-0 073 679 (WILLIAM TATHAM)		
A	DE-A-3 219 086 (BABCOCK)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D06C D06B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16 OCTOBER 1991	Examiner PETIT J.P.
<p>CATEGORY OF CITED DOCUMENTS</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</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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