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

(11) EP 1 972 712 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.09.2008 Bulletin 2008/39

(51) Int Cl.:
D06B 3/28 *(2006.01)*

(21) Application number: **07251255.1**

(22) Date of filing: **23.03.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(71) Applicant: **Falmer Investments Limited**
Road Town, Tortola (VG)

(72) Inventor: **Tsui Tak Ming, William**
Hyde Park Mansion
Causeway Bay
Hong Kong (HK)

(74) Representative: **McGowan, Cathrine**
D Young & Co
120 Holborn
London EC1N 2DY (GB)

(54) Jet fabric dyeing machine

(57) A fabric dyeing machine (3) comprises a travelling tube (39), a storage chamber (36) in communication with both ends of the travelling tube to form an endless travel path for an endless fabric rope (34), a nozzle (38) operable to propel an endless fabric rope around the travel path by directing jets of dye liquor onto the endless fabric rope; and an outer vessel (35) enclosing both the storage chamber (36) and the travelling tube (39). The outer vessel (35) may define the storage chamber, with the travelling tube located inside the outer vessel. The travelling tube (39) and/or the storage chamber (36) may be elongate and arranged along a slope at a few degrees to the horizontal, for example 3 to 5 degrees. A second travelling tube and nozzle can share the storage chamber to give a second endless travel path for the second endless fabric rope.

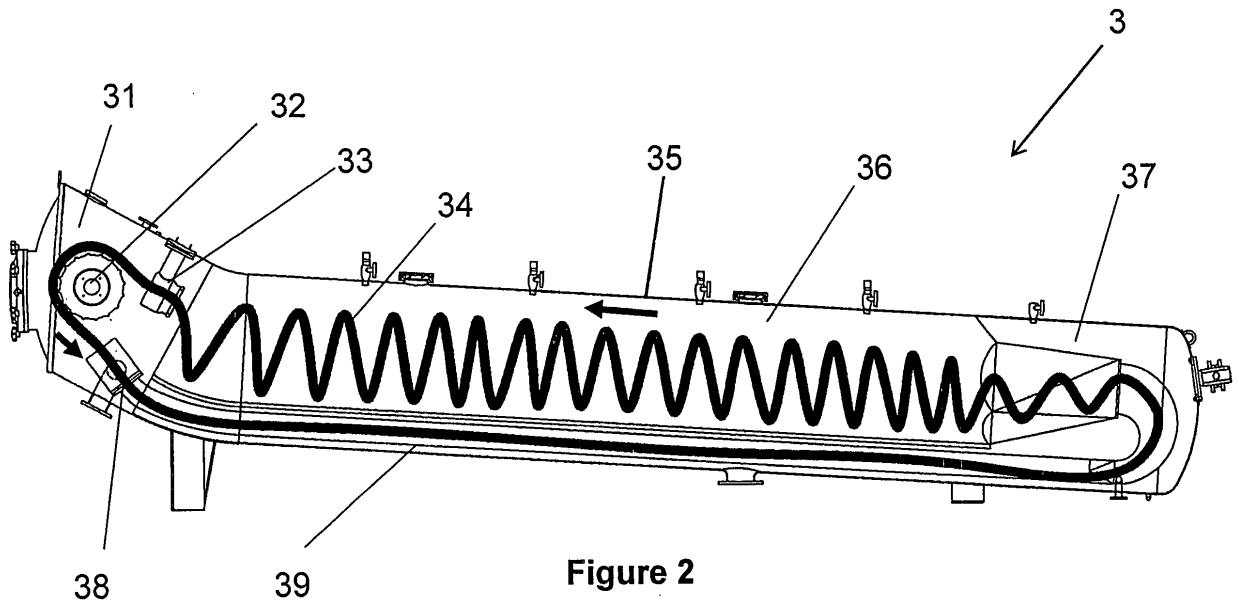


Figure 2

EP 1 972 712 A1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a jet fabric dyeing machine, and improvements thereto.

[0002] Jet fabric dyeing machines are used for the wet treatment (dyeing) of fabric and textile materials arranged in a continuous rope form, which are circulated around the machine for contact with the dye liquor by a jet nozzle which directs dye liquor at high speed onto the fabric and propels it along the direction of travel.

[0003] Conventionally, such machines comprise a nozzle through which the fabric passes for propulsion, a travelling tube connected to the exit of the nozzle along which the fabric travels and in which the fabric is soaked in the dye liquor, a main storage chamber into which the fabric passes from the travelling tube and in which the fabric accumulates while the excess dye liquor drains from it, and a roller that feeds the fabric forward from the storage chamber to the entrance of the nozzle for the next cycle through the machine. The travelling tube and the storage chamber are arranged substantially horizontally, the nozzle directs the fabric downwards, and the nozzle and the travelling tube together form an L-shaped structure.

[0004] Similar machines are described in US 4,019,351 and JP 6-272,152.

[0005] Elongate machines of this type maximise the amount of fabric that a single machine can handle, by allowing long lengths of fabric to be accommodated.

[0006] For woven textiles, especially light-weight materials and those sensitive to crease marks, such as polyester and micro-fibre fabrics, the dyeing temperature and the exchange between the dye liquor and the fabric are critical to the success and quality of the dyeing process. However, an elongate machine occupies a large span, so that the temperature at one end of the machine may be significantly different from that at the other end. Also, the large fabric length may make it difficult to achieve the required exchange between dye liquor and fabric within an acceptable time interval, where inadequate fabric-liquor exchange increases the amount of creasing. The fabric is usually circulated at high speed to give a fabric turn-around time of less than two and a half minutes.

SUMMARY OF THE INVENTION

[0007] A first aspect of the present invention is directed to a fabric dyeing machine comprising: a travelling tube; a storage chamber in communication with both ends of the travelling tube to form an endless travel path for an endless fabric rope; a nozzle operable to propel an endless fabric rope around the travel path by directing jets of dye liquor onto the endless fabric rope; and an outer vessel enclosing both the storage chamber and the travelling tube.

[0008] Many parameters affect the quality of the dyeing process, one of which is temperature. Dyeing is generally carried out at an elevated temperature, for example by heating the dye liquor applied to the fabric. A conventional jet dyeing machine has the travelling tube and storage chamber exposed, which allows temperature differences and gradients to arise across the machine, which is typically elongate with a substantial length. This uneven temperature can be detrimental to dyeing quality. The present invention proposes to address this by enclosing both the travelling tube and the storage vessel in the same outer vessel, which acts to reduce temperature differences and maintain a more even and constant temperature profile across the whole of the machine.

[0009] In some embodiments, the outer vessel may define the storage chamber, with the travelling tube contained within the outer vessel. This structure is a particularly simple way of implementing the invention, since the need for an additional outer vessel is eliminated by using the storage chamber itself as the outer vessel and locating the travelling tube inside it, instead of the conventional external position.

[0010] In such an arrangement, the travelling tube may be positioned in a lower part of the outer vessel. This is advantageous in that the tube displaces a volume of the dye liquor that collects in the bottom of the storage chamber/outer vessel for recirculation to the nozzle, so that the overall volume of dye liquor required is lower and the liquor ratio can be smaller.

[0011] The machine may further comprise an array of bars positioned above the travelling tube and which define a lower boundary of the storage chamber. The bars demarcate the storage chamber from the travelling tube in the base of the outer vessel, and allow excess dye liquor that separates from the fabric in the storage chamber to drain through to the base of the vessel for collection and recirculation to the nozzle.

[0012] The bars may be provided with a coating of a low-friction material. This reduces friction between the bars and the fabric, which eases the passage of the fabric along the endless travel path and also reduces wear and tear on the fabric that could otherwise arise from contact with the bars.

[0013] In some embodiments, an end of the travelling tube may be connected to an exit of the nozzle, and slope downwards from the nozzle. This allows gravity to contribute to propelling the fabric rope, which increases the travel speed of the fabric without having to increase the power of the dye liquor jets applied by the nozzle.

[0014] The travelling tube may slope down at an angle to the horizontal of at least 3 degrees. For example, the travelling tube may slope down at an angle to the horizontal of between 3 and 5 degrees inclusive. This range of angles is a comprise between maximising the useful contribution of gravity by having a large slope and providing a sufficient depth and volume of dye liquor in the travelling tube for soaking the fabric, which requires a shallow or zero slope.

[0015] The storage chamber may slope upwards with respect to the direction of travel of an endless fabric rope through the storage chamber. An upwardly sloping storage chamber improves the separation of dye liquor from fabric in the storage chamber, and also improves collection of the separated liquor because it drains to the lower end of the chamber. For example, the storage chamber may slope upwards at an angle to the horizontal of between 3 and 5 degrees inclusive.

[0016] In embodiments having sloping components, the travelling tube and the storage chamber may be substantially parallel. This reduces the overall bulk of the machine, and minimises the volume of the outer vessel.

[0017] The fabric dyeing machine may further comprise an access door through which the interior of the machine can be accessed, the door located in an end wall of the outer vessel, and located in a substantially vertical plane. The end wall of the outer vessel in which the door is located may be elevated. The outer vessel may have a non-horizontal longitudinal axis in the region of the end wall that is substantially not orthogonal to the vertical plane of the door. Doors arranged in this way are easier to operate and provide easier and safer access to the interior of the machine. Particularly in machines in which the travelling tube and storage chamber are sloped, the access door can be a significant height above the ground, so angling it appropriately improves access and ease of use.

[0018] In further embodiments, the fabric dyeing machine may further comprise a second travelling tube, the storage chamber in communication with both ends of the second travelling tube to form a second endless travel path for an endless fabric rope; and a second nozzle operable to propel an endless fabric rope around the second travel path by directing jets of dye liquor onto the endless fabric rope; in which the outer vessel also encloses the second travelling tube. A second travelling tube and nozzle that share the same storage chamber with the first travelling tube and nozzle doubles the capacity of the machine without increasing its size, and requires less components and is less costly than having two separate machines. Also, the liquor ratio can be less for a double capacity machine than for two separate machines each dyeing one fabric rope.

[0019] As for a machine with a single travel path, the outer vessel may define the storage chamber, with both the said travelling tube and the second travelling tube contained within the outer vessel. The said travelling tube and the second travelling tube may be positioned in a lower part of the outer vessel.

[0020] The fabric dyeing machine may further comprise a partition that divides the storage chamber into two parts, one part comprised within the said endless travel path and one part comprised within the second endless travel path. This keeps the two ropes of fabric from becoming entangled in the storage chamber.

[0021] At least a portion of the or each travelling tube may have a rectangular cross-section. The application of jets of dye liquor in the nozzle tends to twist and rotate the fabric, which is undesirable. A rectangular travelling tube reduces this effect compared to a conventional circular cross-section travelling tube. In particular, the or each travelling tube may have a rectangular cross-section where it is connected to an exit of its associated nozzle; this resists the twisting and spiralling effect close to its source so that it is reduced more effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] For a better understanding of the invention and to show how the same may be carried into effect reference is now made by way of example to the accompanying drawings in which:

Figure 1 shows an exterior side view of a conventional high speed jet fabric dyeing machine;
Figure 2 shows a cross-sectional side view of a jet fabric dyeing machine according to an embodiment of the invention;
Figure 3 shows an exterior side view of the jet fabric dyeing machine of Figure 2;
Figure 4 shows a transverse cross-sectional view of a jet fabric dyeing machine according to a further embodiment of the invention; and
Figure 5 shows a perspective view of a twin nozzle assembly according to an embodiment of the invention.

DETAILED DESCRIPTION

[0023] Figure 1 shows an exterior side view of a conventional high speed jet fabric dyeing machine, through which an endless rope of fabric is circulated by a jet of dye liquor directed onto the fabric by a nozzle, the dye liquor being re-circulated within the machine so that liquor which has been applied to the fabric and then drained off is supplied back to the nozzle.

[0024] The dyeing machine 1 comprises a main storage chamber 11 in the form of a horizontally arranged large diameter pipe or cylindrical vessel. One end of the storage chamber slopes upwards, and has an outlet therein which connects to the entrance of a tubular nozzle 12. The nozzle 12 is also cylindrical, of smaller diameter than the storage chamber 11, and directed in a substantially downwards direction. Fabric can pass through the nozzle 12, which is provided with nozzle gaps or jets through which a high speed jet or jets of dye liquor are directed downwardly and inwardly onto the fabric inside the nozzle, thus propelling the fabric through the nozzle, in a forward circulation direction.

[0025] The nozzle 12 is connected at its outlet to a travelling tube 13, arranged substantially horizontally under the storage chamber 11, and having a much smaller diameter than the storage chamber 11. The end of the travelling tube 12 remote from the nozzle 12 turns upwards and is connected to the end of the storage chamber

11 that is remote from the nozzle 12. Thus, the main storage chamber 11, the nozzle 12 and the travelling tube 13 together form a vessel in the shape of a continuous elongate tubular ring of varying diameter. This defines an endless travel path through the vessel, along which a continuous rope of fabric can be circulated for dyeing.

[0026] A door 10 is provided at the end of the storage chamber 11 nearest to the nozzle 12, giving access to the interior of the machine 1 so that the fabric can be inserted and removed. The machine 1 further includes a rotating roller positioned inside the storage chamber 11 and slightly upstream of the entrance to the nozzle 12, at the position 14. The axis of rotation of the roller is orthogonal to the plane of the path of the fabric rope, so that the fabric rope passes over the outside of the roller and is pulled along by the roller so that fabric is supplied from the storage chamber 11 into the nozzle 12.

[0027] The machine 10 also incorporates a dye liquor circulation system, which collects dye liquor that drains off the fabric and supplies it to the nozzle 12 to be jetted onto the fabric. A volume of liquor is contained in the travelling tube 13 so that the fabric can soak in the liquor as it passes through the travelling tube. Liquor later drains from the fabric while it is in the storage chamber 11, and is collected from the bottom of the storage chamber and pumped back to the nozzle 12.

[0028] The speed of travel of the fabric, together with the required dyeing cycle time for the fabric, limits the maximum length of fabric that can be circulated within the machine. The capacity can therefore be relatively low, particularly for light-weight fabrics. The speed of travel can be raised with a view to increasing the total output capacity of the machine. To increase the travelling speed, the nozzle is generally positioned vertically, as in Figure 1, and propels the fabric downwards.

[0029] However, for a high speed, it is still necessary to allow adequate time for liquor exchange between the fabric and the dye liquor. This takes place largely in the travelling tube 13, where the fabric is soaked for about four or five seconds before being passed to the storage vessel 11. The travelling tube is positioned horizontally to maintain the reservoir of dye liquor over its full length. The combination of vertical nozzle 12 and horizontal travelling tube 13 together comprise a long L-shaped structure.

[0030] After the fabric has been soaked in the travelling tube 13, it moves upwards into the main storage chamber 11. In order to decrease the water consumption per weight of fabric, known as the liquor ratio, the dye liquor is separated from the fabric in the storage chamber 11, by being allowed to drain off the fabric, which is accumulated in folds within the storage chamber 11. The separated dye liquor enters the circulation pipe work and is returned by pump to the nozzle 12. Once the accumulated fabric has moved forward to the front of the storage chamber 11, it is taken up by the roller and fed into the nozzle 12 for another dye liquor exchange cycle.

[0031] The jet flow of the dye liquor onto the fabric typically results in a transporting speed in the range 200 to 300 metres per minute. This is the highest suitable speed that is normally achieved in a machine such as that of Figure 1, balancing the needs for circulation time, liquor ratio and smooth running of the fabric. The temperature at which the dyeing process is carried out is also important, and the dye liquor is often heated, for example by passing through a heat exchanger incorporated into the dye liquor circulation pipe system.

[0032] Figure 2 shows a cross-sectional side view of a jet fabric dyeing machine in accordance with an embodiment of the present invention. The machine 3 comprises a main storage chamber 36, a roller 32, a nozzle 38 and a travelling tube 39 arranged in sequence as in the conventional machine of Figure 1. Dyeing of the endless fabric rope 34 is carried out in the conventional manner described above, the direction of travel of the fabric being shown by the arrows. However, the machine 3 includes a number of additional features aimed at improving the dyeing process.

[0033] Primarily, the storage chamber 36 and the travelling tube 39, which are elongate and arranged one above the other, are housed within a common outer vessel 35 that encloses both components (and, in this example, also the nozzle 38 and the roller 32). This structure addresses the problems of temperature difference that can arise between the storage chamber and travelling tube, and also across the different ends thereof, in a machine where these components are external and separate, as in Figure 1. Reducing or eliminating temperature differences improves the quality of the dyeing process, giving a more evenly dyed fabric, since the dyeing result is temperature-dependent.

[0034] In the example of Figure 2, the outer vessel 35 and the storage chamber 36 are defined by the same tubular wall, and the travelling tube 39 is located inside that tubular wall. Use of a common wall for the outer vessel 35 and the storage chamber 36 provides a simple structure, with less material needed to make the machine 3. Alternatively, however, both the storage chamber 36 and the travelling tube 39 can be discrete structures positioned inside a separate enclosing outer vessel 35 that does not form part of either the storage chamber 36 or the travelling tube 39. This arrangement may improve temperature uniformity, since dye liquor in both the storage chamber 36 and the travelling tube 39 is separated from the external environment by two walls.

[0035] A further advantage of the former arrangement, in which the outer vessel defines the storage chamber and the travelling tube is located within the lower part of the outer vessel, is that the travelling tube displaces liquor collecting in the bottom of the storage chamber/outer vessel, allowing a smaller total volume of liquor to be used thereby reducing the liquor ratio of the machine. A lower liquor ratio is more cost-effective, since the same weight of fabric can be dyed using a smaller volume of dye liquor.

[0036] As well as reducing temperature differences, it is desirable to achieve a higher fabric circulating speed

than is possible in conventional machines. Increasing the propulsion power produced by the dye liquor jet from the nozzle can be used for this, but this changes the liquor ratio, which is undesirable. Also, a higher pressure liquid jet causes more friction between the fabric and the dye liquor, which can damage the structure and surface texture of the fabric.

[0037] Consequently, the present invention proposes to address this problem by arranging the travelling tube 39 along a downward slope from the exit of the nozzle 38, in place of the conventional horizontal travelling tube.

[0038] A downward slope for the travelling tube 39 allows gravitational force to assist movement of the fabric rope 34 along the travelling tube 39, thereby increasing fabric travelling speed without increasing the pressure of the dye liquor jet applied by the nozzle 38. However, the angle of the downward slope should be carefully chosen to balance the advantage given by gravity against the need to maintain a sufficient volume of dye liquor within the travelling tube 39 for liquor exchange with the fabric.

[0039] It has been found that angles with the horizontal of 3 degrees or more are particularly advantageous, with the optimum angle with the horizontal for downward slope of the travelling tube 39 being in the range 3 to 5 degrees inclusive.

[0040] The storage chamber 36 can also usefully be positioned at a small angle to the horizontal, but sloping uphill with respect to the direction of travel of the fabric rope 34, i.e. sloping up to the roller 32 and the nozzle 38. The range of 3 to 5 degrees inclusive is again beneficial. Also, the storage chamber 36 can be arranged parallel with the travelling tube 39. This minimises the volume of the outer vessel 35, and minimises the total space occupied by the machine as a whole. An upward slope on the storage vessel 36 helps liquor to separate from the fabric, and also helps the liquor to collect at the rear end 37 of the storage chamber 36. Thus, liquor separation is more effective and occurs earlier, and the separated liquor can be more easily collected into the circulation pipe work. However, the slope should not be too steep, because the fabric is required to travel upwards through the storage chamber 36, which is more difficult for a steeper angle.

[0041] Figure 3 shows an exterior side view of the machine 3 of Figure 2, showing how the outer vessel 35 encloses all the components. The elongate outer vessel 35 is supported near each end on legs 22 that are longer at the end closest to the nozzle, to give the desired slope to the travelling tube and the storage vessel. The machine is also provided with a door 21 in the outer vessel 35. The door 21 gives access to the interior of the machine, and allows fabric for dyeing to be inserted into the machine 3, and removed after dyeing. The door 21 is provided in an end wall of the outer vessel 35 closest to the end of the machine where the nozzle is located. In a conventional machine such as that of Figure 1, the access door is similarly positioned in an end wall of the storage chamber, where the end wall is substantially orthogonal to the longitudinal axis of the storage chamber at its end. However, if such an arrangement is adopted in a machine having a sloped configuration in accordance with embodiments of the present invention, the door 21 will be difficult to access owing to the height of the nozzle end of machine that results from the slope. Therefore, in an embodiment of the invention, it is proposed to retain a door in the end wall of the machine adjacent to the nozzle, but to arrange the end wall/door at an angle to the plane orthogonal to the longitudinal axis of the end part of the outer vessel, so that the door is closer to the vertical than it would otherwise be. This gives a door which is easier to access and operate. In some embodiments, the door 21 is arranged in a vertical plane.

[0042] In a further embodiment, it is proposed to increase the capacity of the machine by configuring it for the simultaneous processing of two endless fabric ropes. This can be achieved by providing two nozzles and two travelling tubes arranged side-by-side under the storage chamber. Each nozzle and travelling tube assembly accommodates a separate fabric rope. However, the two nozzle and travelling tubes assemblies share a common storage chamber. A vertical longitudinal partition can be provided to partially divide the storage chamber. This separates the two circulating ropes and prevents them from becoming entangled while in the storage chamber.

[0043] Figure 4 shows a transverse cross-sectional view through a machine according to this embodiment, at a midpoint along the outer vessel. This shows the two travelling tubes 39 arranged next to one another in the bottom part of the outer vessel 35, while the upper part of the outer vessel 35 defines the storage chamber 36, which is shared by the two travelling tubes. A vertical partition or separating plate 42 arranged along the centre of the storage chamber 36 divides the storage chamber into a left part 41A and a right part 41B, to provide a storage chamber part for each travelling tube 39. The lower boundary of the storage chamber parts 41A, 41B is lined with an array or grid of spaced apart metal bars 43. Preferably these are coated with Teflon (RTM) or a similar non-stick or low friction material, to reduce friction between the bars and the fabric that could wear or damage the fabric. Thus the bars 43 lie between the storage chamber 36 and the travelling tubes 39. The bars 43 keep the circulating fabric within the storage chamber while allowing the dye liquor that separates from the fabric to drip down into the lower part of the outer vessel for collection and re-circulation by the liquor circulation system (not shown). The circulation system uses a single pump to supply the dye liquor to the two nozzles, to ensure that the dyeing parameters are maintained the same for each fabric rope. This is enhanced by the shared storage tank, which also allows a common volume of dye liquor to be used for both fabric ropes. Thus the same dyeing effect is achieved for both ropes, and quality is maintained between ropes while the capacity is doubled.

[0044] The coated metal bars can also be employed in a machine with just one nozzle and travelling tube assembly.

[0045] Figure 5 shows a perspective view of part of a parallel nozzle and travelling tube assembly. In this example, the two nozzles 38 are defined in a single nozzle element 50; however, separate elements could be used. The nozzles are circular apertures through which the fabric passes. Gaps defined in the wall of each aperture direct the jets of dye liquor onto the fabric rope to propel it into the associated travelling tubes 39. The travelling tubes 39 are pipes or tubes connected to the exit of the associated nozzle 38. The pipes may have a circular cross-section along their whole length (not shown).

[0046] However, the use of liquid jets to propel the fabric, and the high travelling speeds, tends to impart a slight twist to the fabric. Over the long term, this can cause problems. It is therefore desirable to minimise the twisting.

[0047] An embodiment of the present invention addresses this by proposing the use of travelling tubes with a rectangular cross-section (where rectangular includes square), instead of the conventional circular cross-section pipes. A rectangular travelling tube reduces spiral movement of the fabric rope induced by the dye liquor jets and hence effectively reduces twisting of the travelling fabric. Figure 5 shows two parallel travelling tubes 39 having rectangular cross-section that are connected to the exits of the two parallel nozzles 38. The rectangular cross-section can extend over all or part 51 of the travelling tubes 39, which may then be coupled to circular pipes 52 for easier connection with the other parts of the machine (connection to the storage chamber 36).

[0048] A rectangular cross-section can also be used in a machine having only one travelling tube and nozzle.

[0049] Similarly, other features of the fabric dyeing machine described above can be employed without others of the features. For example, a sloping travelling tube and/or a sloping storage chamber can be used in a machine that does not include an outer vessel to enclose both of those components. Only one of the travelling tube and the storage chamber may be sloped. An access door that is angled to the general longitudinal axis of the machine, or a door that is angled generally towards the vertical, can be used to enhance ease of access to the interior of any dyeing machine where the door would otherwise be difficult to reach.

REFERENCES

[0050]

[1] US 4,019,351
[2] JP 6-272,152

Claims

1. A fabric dyeing machine (3) comprising:

a travelling tube (39);
a storage chamber (36) in communication with both ends of the travelling tube to form an endless travel path for an endless fabric rope (34);
a nozzle (38) operable to propel an endless fabric rope around the travel path by directing jets of dye liquor onto the endless fabric rope; and
an outer vessel (35) enclosing both the storage chamber and the travelling tube.

2. A fabric dyeing machine according to claim 1, in which the outer vessel defines the storage chamber, and the travelling tube is contained within the outer vessel.

3. A fabric dyeing machine according to claim 2, in which the travelling tube is positioned in a lower part of the outer vessel.

4. A fabric dyeing machine according to claim 3, and further comprising an array of bars (43) positioned above the travelling tube and which define a lower boundary of the storage chamber.

5. A fabric dyeing machine according to claim 4, in which the bars are provided with a coating of a low-friction material.

6. A fabric dyeing machine according to any one of claims 1 to 5, in which an end of the travelling tube is connected to an exit of the nozzle, and slopes downwards from the nozzle.

7. A fabric dyeing machine according to claim 6, in which the travelling tube slopes down at an angle to the horizontal of at least 3 degrees.

8. A fabric dyeing machine according to claim 6, in which the travelling tube slopes down at an angle to the horizontal of between 3 and 5 degrees inclusive.

9. A fabric dyeing machine according to any one of claim 1 to 8, in which the storage chamber slopes upwards with respect to the direction of travel of an endless fabric rope through the storage chamber.

10. A fabric dyeing machine according to claim 9, in which the storage chamber slopes upwards at an angle to the horizontal of between 3 and 5 degrees inclusive.

11. A fabric dyeing machine according to any one of claims 6 to 10, in which the travelling tube and the storage chamber are substantially parallel.

12. A fabric dyeing machine according to any one of the preceding claims, and further comprising an access door (21) through which the interior of the machine can be accessed, the door located in an end wall of

the outer vessel, and located in a substantially vertical plane.

13. A fabric dyeing machine according to claim 12, in which the end wall of the outer vessel in which the door is located is elevated.

14. A fabric dyeing machine according to claim 12 or claim 13, in which the outer vessel has a non-horizontal longitudinal axis in the region of the end wall that is substantially not orthogonal to the vertical plane of the door.

15. A fabric dyeing machine according to any preceding claim, and further comprising:

a second travelling tube (39), the storage chamber in communication with both ends of the second travelling tube to form a second endless travel path for an endless fabric rope; and
a second nozzle (38) operable to propel an endless fabric rope around the second travel path by directing jets of dye liquor onto the endless fabric rope;

in which the outer vessel also encloses the second travelling tube.

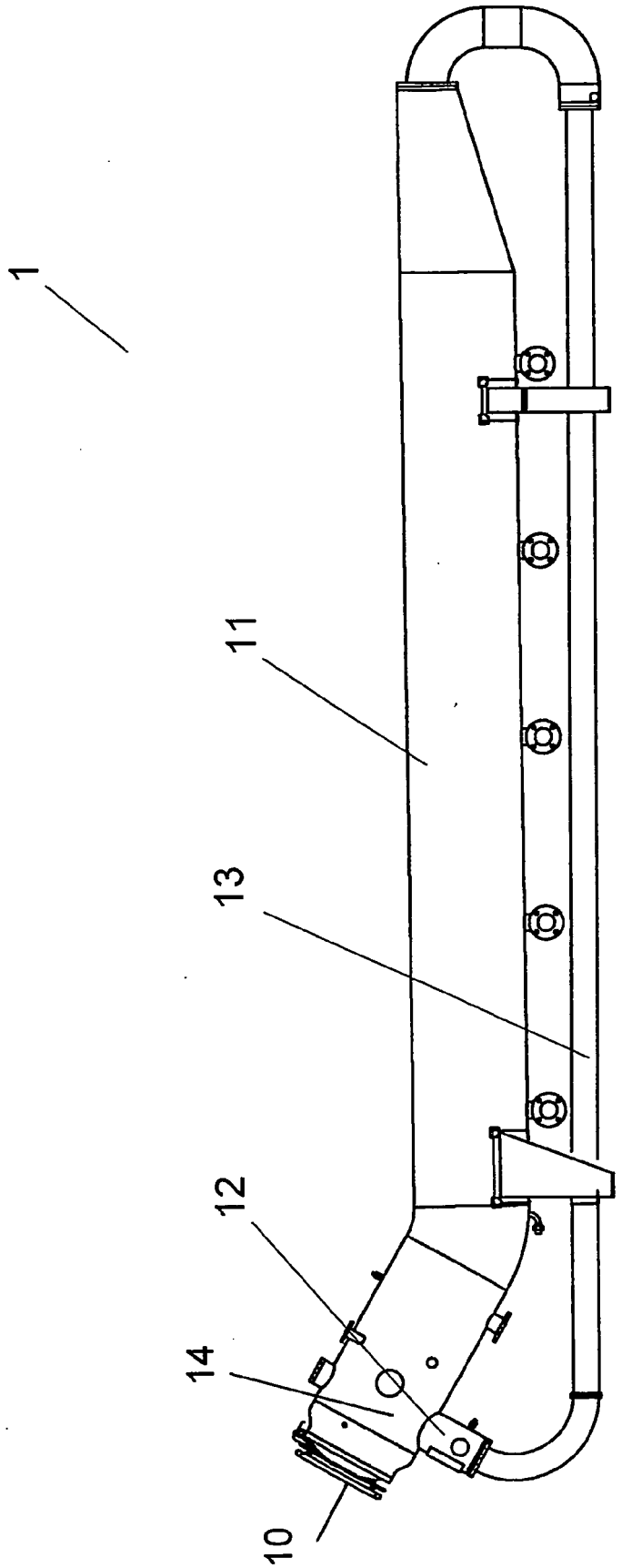
16. A fabric dyeing machine according to claim 15, in which the outer vessel defines the storage chamber and both the said travelling tube and the second travelling tube are contained within the outer vessel.

17. A fabric dyeing machine according to claim 16, in which the said travelling tube and the second travelling tube are positioned in a lower part of the outer vessel.

18. A fabric dyeing machine according to any one of claims 15 to 17, further comprising a partition (42) that divides the storage chamber into two parts (41A, 41B), one part comprised within the said endless travel path and one part comprised within the second endless travel path.

19. A fabric dyeing machine according to any preceding claim, in which at least a portion of the or each travelling tube has a rectangular cross-section.

20. A fabric dyeing machine according to claim 19, in which the or each travelling tube has a rectangular cross-section where it is connected to an exit of its associated nozzle.



PRIOR ART

Figure 1

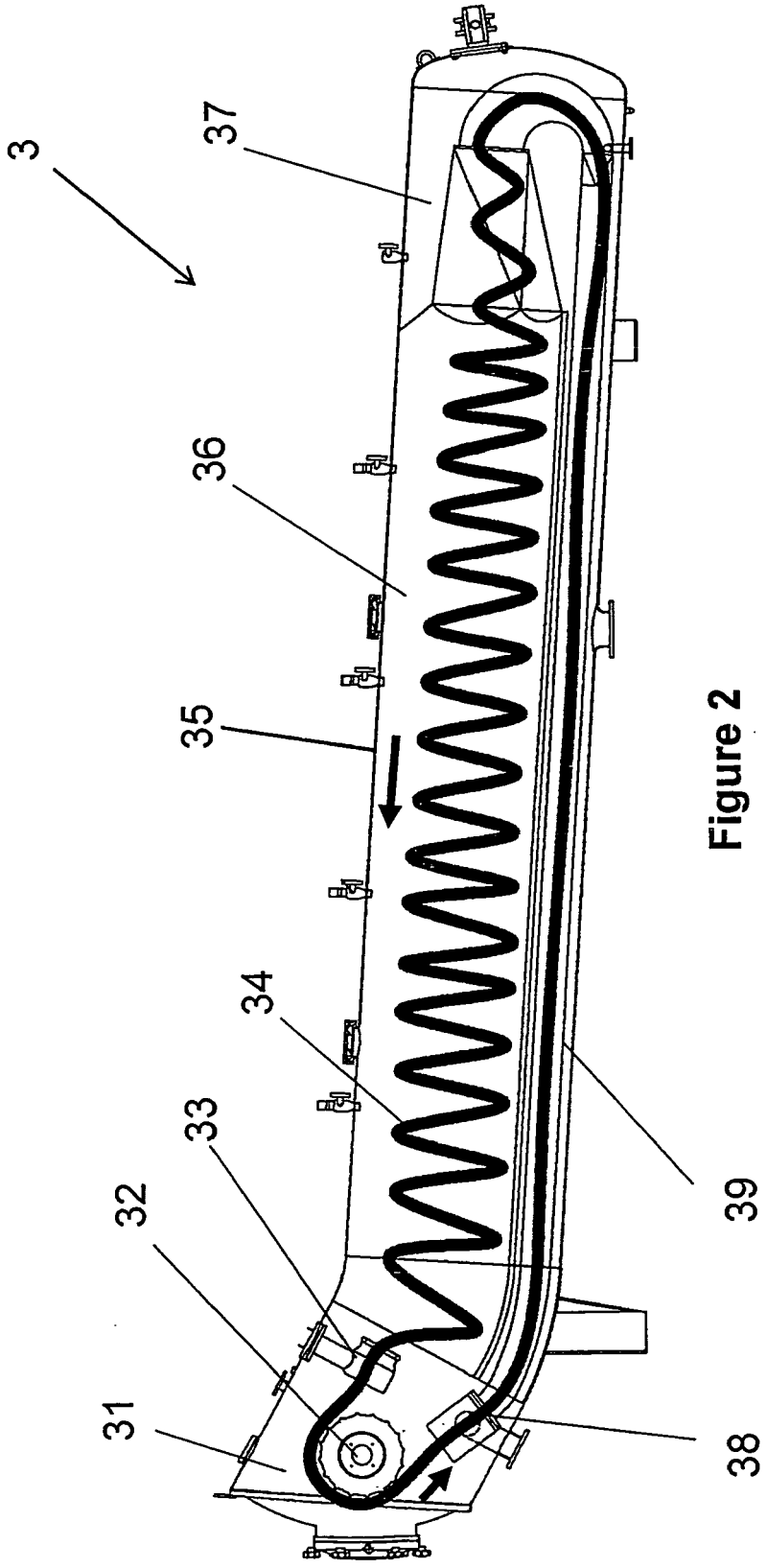


Figure 2

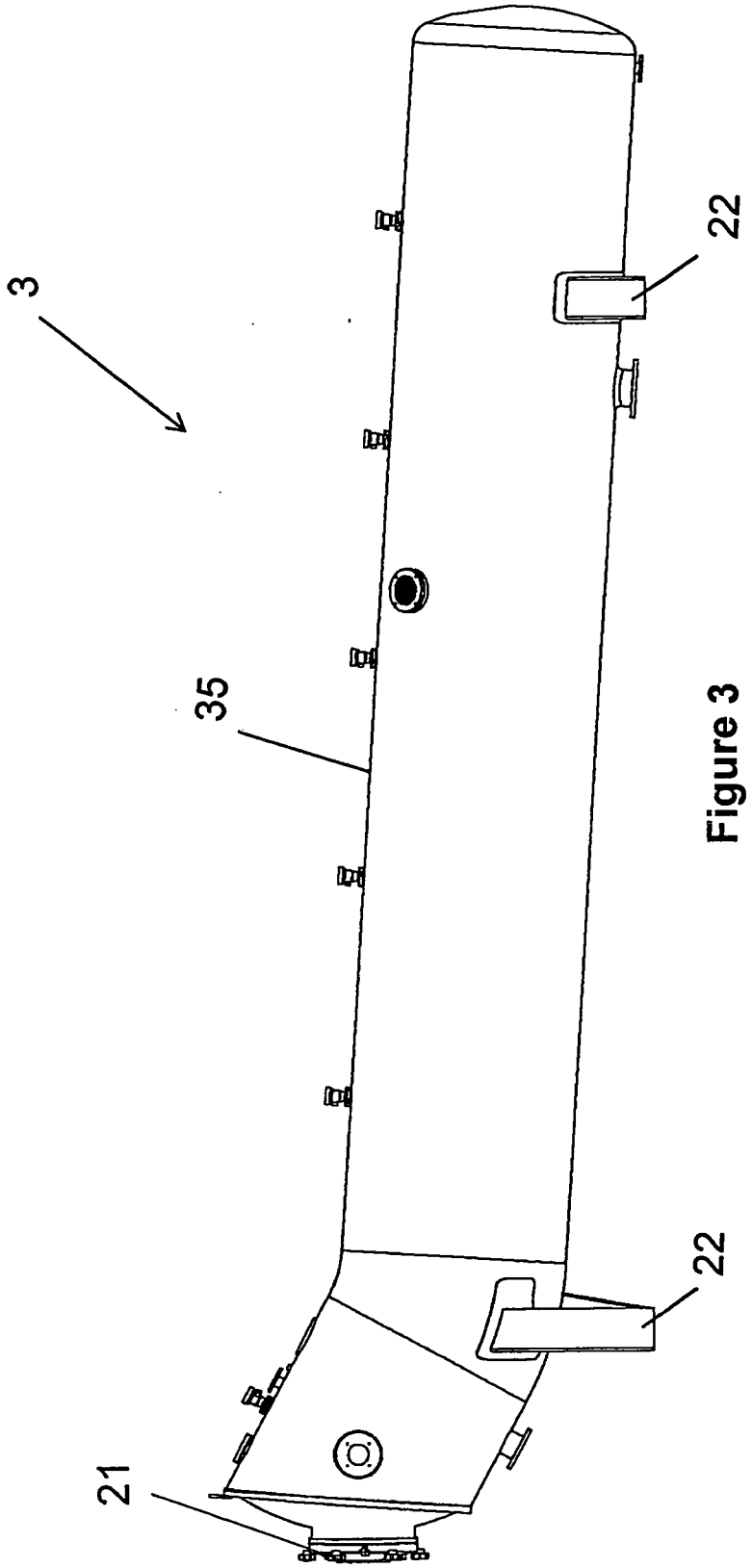


Figure 3

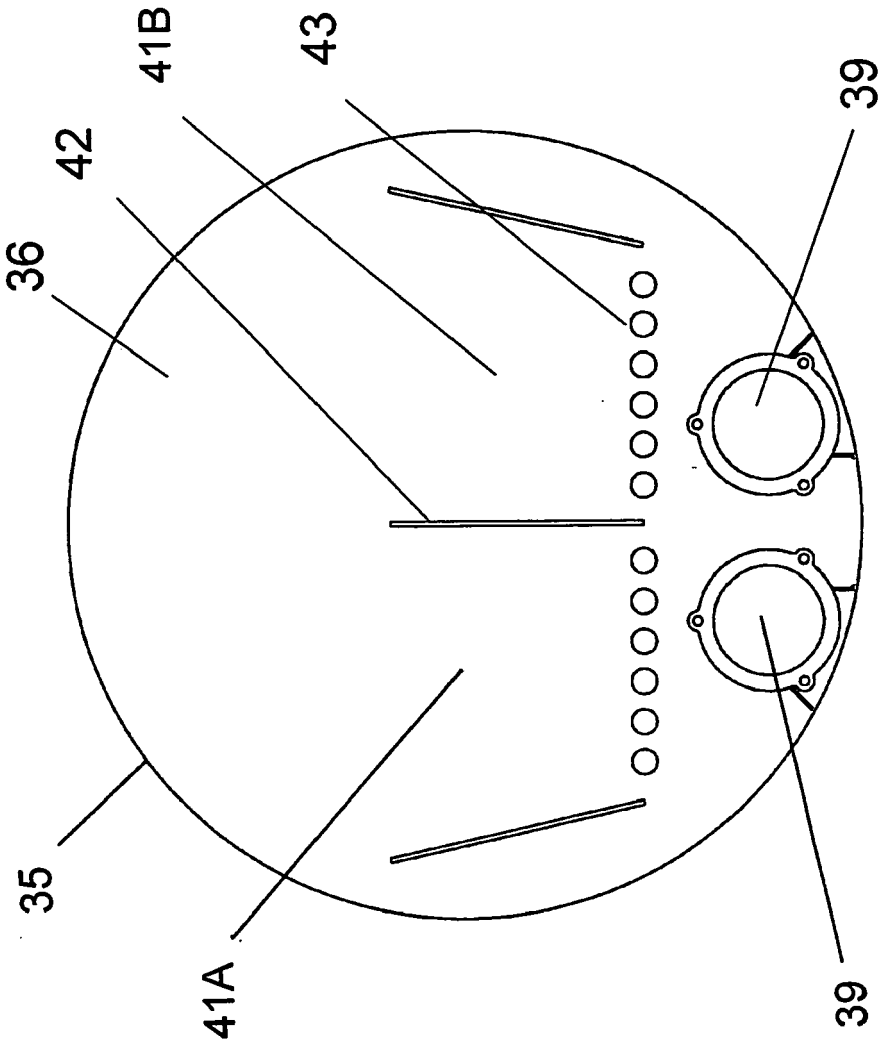


Figure 4

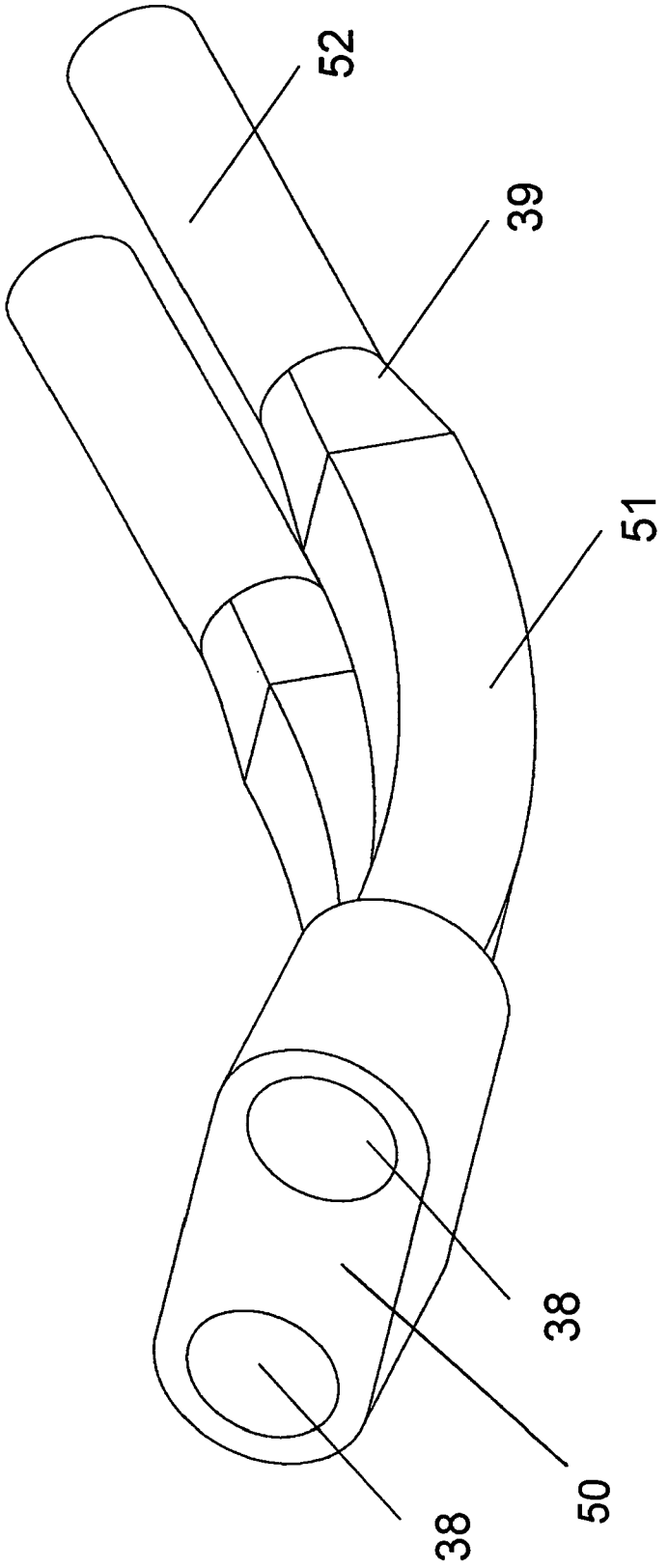


Figure 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 25 1255

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 762 189 A (MARSH F ET AL) 2 October 1973 (1973-10-02) * column 2, line 54 - column 3, line 51 *	1-3,6,7, 9,11-13, 19,20	INV. D06B3/28
X	FR 2 178 534 A (ARGELICH TERMES & CO [ES]) 9 November 1973 (1973-11-09) * the whole document *	1,3,6,7, 11,15-20	
X	DE 28 50 697 A1 (BRUECKNER APPARATEBAU GMBH) 4 June 1980 (1980-06-04) * page 5, lines 3-30 *	1,4-6	
X	FR 2 667 332 A3 (DURAND CO MP [FR]) 3 April 1992 (1992-04-03) * the whole document *	1,15,16, 19,20	
X	US 5 713 223 A (LIN TENG CHI [TW]) 3 February 1998 (1998-02-03) * abstract; figures 3,4 *	1,15-17	
A	US 5 520 027 A (MCCARTNEY PHILLIP D [US] ET AL) 28 May 1996 (1996-05-28) * column 4, lines 1-21; figure 2 *	4	TECHNICAL FIELDS SEARCHED (IPC) D06B
A	US 4 578 085 A (ISHIMARU OSAMU [JP]) 25 March 1986 (1986-03-25) * abstract; figure 1 *	12,13	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 July 2007	Bichi, Marco

CATEGORY OF CITED DOCUMENTS

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
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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 25 1255

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-07-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3762189 A	02-10-1973	FR 2133417 A5	24-11-1972
FR 2178534 A	09-11-1973	ES 402434 A1	01-11-1972
		GB 1380816 A	15-01-1975
		IT 982647 B	21-10-1974
		US 3837187 A	24-09-1974
		ZA 7207674 A	31-10-1973
DE 2850697 A1	04-06-1980	NONE	
FR 2667332 A3	03-04-1992	NONE	
US 5713223 A	03-02-1998	DE 19534381 A1	20-03-1997
		GB 2304739 A	26-03-1997
US 5520027 A	28-05-1996	NONE	
US 4578085 A	25-03-1986	JP 61070065 A	10-04-1986

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4019351 A **[0004] [0050]**
- JP 6272152 A **[0004] [0050]**