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(54) Process for dyeing textile material

(57) A process for dyeing textile material; in which the textile material is dipped into a hot dyeing-bath comprising a dyeing or colouring substance, and agents for dispersing and fixing the colouring substance to the textile material. The dispersing agent is provided by a metered quantity of ethyl alcohol, while the fixing agent comprises acetic acid and sodium salts which are mixed into the dyeing bath at a first temperature lower than the boiling temperature. The dyeing bath is subsequently heated, during dyeing of the textile material, and maintained at a second temperature close to the boiling point of the same dyeing-bath.

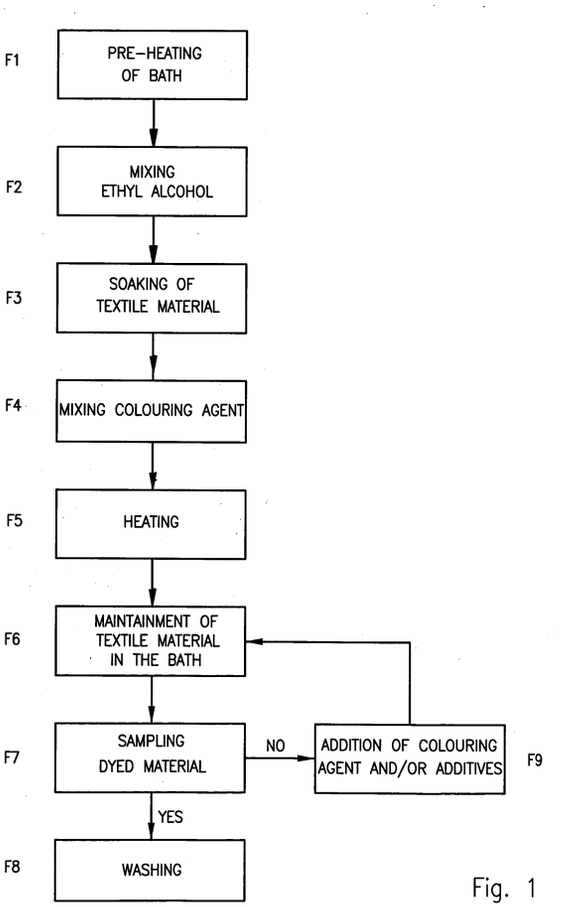

Fig. 1

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Description

BACKGROUND OF THE INVENTION

[0001] The invention concerns the dyeing of textile material, and in particular refers to an innovative dyeing process for loose fibres, yarns or fabrics in the textile industry; the invention also concerns the dyeing-bath, as well as the dyed product in loose fibres, yarns or fabric material dyed by means of the aforesaid process.

STATE OF THE ART

[0002] The conventional dyeing processes for textile material, comprise various treatment steps such as preparation of the dyeing-bath, which is maintained at a pre-established temperature, in which is the textile material in the form of loose fibres, yarn or fabric, is dipped and maintained in the dyieng bath for a long time; the bath usually comprises at least one dyieng or colouring substance, levelling and, anti-rope agents, or surfactans, in an aqueous liquor.

[0003] The bath is subsequently heated and brought up to a temperature close or equivalent to the boiling point, so as to disperse the colouring agent fixing the same to the fibres in presence of an acid, neutral or slightly alkaline environment; the length of time the fibres remain in the high-temperature bath generally depends on the chemical system and in particular the additives used for the bath.

[0004] In a conventional dyeing process it is also necessary for the textile material to remain in the bath for an extremely long period of time, for example ranging from two to three hours.

[0005] After the dispersion and fixing of the colouring substance to the textile material, served washing steps must be carried out to remove from the dyed material the excess of colour; in particular, it is normally necessary to carry out four or more washing steps, depending on the intensity of the colouring, which entail a high consumption of water and time in order to achieve good results.

[0006] Therefore, a conventional dyeing process requires a very long period of time, which has a negative effect in terms of productivity and due to the greater use of manpower.

[0007] Moreover, the additives usually used for a conventional dyeing-bath, in addition to their considerable cost, involve serious ecological problems, in that, unless appropriate measures are taken, the disposal of surfactans and the other additive used in a conventional dyeing process, can cause extensive pollution of the environment; moreover, treating the water in storage tanks, before its disposal, in turn entails considerable costs, and still involves the risk of pollution in the event of breakdowns or malfunctioning of the plant.

[0008] Lastly, further problems derive from the high consumption of water required for the various washes, due to the difficulty in supplying, and the excessive exploitation of the environmental water resources.

OBJECTS OF THE INVENTION

[0009] The main object of this invention is to provide an innovative process for dyeing textile material, whereby it is possible to greatly reduce the dyeing times, consequently resulting in considerable economic advantages in terms of increased productivity, and reduction of costs and labour required for carrying out the process and running the dyeing plant.

[0010] A further object of this invention is to provide a process for dyeing textile material having good ecological characteristics, thereby contributing limiting the environmental pollution deriving from conventional dyeing processes, allowing at the same time a more efficient utilisation of the water resources.

BRIEF DESCRIPTION OF THE INVENTION

[0011] All the above can be achieved by means of a dyeing process according to claim 1.

[0012] More precisely, according to an aspect of the invention, a dyeing process has been provided for dyeing textile material in a dyeing bath comprising a dyeing or colouring agent, as well as a colour dispersing agent and a colour fixing agent, as dye assisting agents, in a heated water solution, and in which the textile material is dipped into a headed dyeing bath maintaining the textile material in a dipped condition for a length of time, characterized by mixing a metered quantity of ethyl alcohol, as colour dispersing agent, during heating of the dyeing bath.

[0013] According to the invention, a weak acid, such as acetic acid or wood vinegar, is used as colour fixing agent; a sodium salt such as sodium cloride or sodium sulphate, may also be added and dissolved into the dyeing bath to assist in the absorption of the dye or colouring agent by the fibres of the textile material.

[0014] The invention is directed also to a dyeing bath according to claim 24 and a dyed textile material according to claim 29.

[0015] Further features of the invention are specified in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] These and further features according to this invention, will be more clearly evident from the following description with reference to the accompanying drawings, in which:

- Fig. 1 shows a block diagram of a dyeing process according to the invention;
- Fig. 2 shows a dyeing apparatus for carrying out the dyeing process.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The general features and a preferred mode of performing the dyeing process according to this invention, will be illustrated in more details hereunder with reference to the block diagram shown in figure 1.

[0018] The process for dyeing textile material according to the invention, comprises a first step F1 in which a pre-established quantity of water to form a dyeing-bath, is pre-heated to a first temperature lower than boiling temperature point at the dyeing bath.

[0019] Subsequently, in a second step F2, a metered quantity of ethyl alcohol is mixed in the water of the dyeing-bath, which thus assumes a slightly acid pH value, ranging for example from 5 to 7. However, this does not exclude the possibility of using, in addition to ethyl alcohol, other ecological substances, for example sodium chloride or sodium sulphate salts capable of facilitating the yield of the colouring agent from the bath to the textile material, and to avoid pollution, according to particular dyeing requirements.

[0020] The temperature of the dyeing-bath during the addition of the ethyl alcohol should be maintained at a constant value considerably lower than the boiling temperature of the same ethyl alcohol, for example a temperature ranging from 50° to 70°C, preferably from 55° to 65°C; the aforesaid temperature make it possible to limit the evaporation of the ethyl alcohol from the dyeing-bath, even though, depending upon dyeing requirements, higher or lower heating temperatures are possible.

[0021] During or successively the mixing of ethyl alcohol, a metered quantity of salt and or weak acid may be added to the aqueous solution, to improve dyeing.

[0022] According to a preferential mode of the dyeing process of the invention, sodium cloride salt may be added in a quantity ranging from 2% to 40% in respect to the weight of the textile material to be dyed in the bath, preferably between 5% and 20%.

[0023] Correspondingly, acetic acid or wood vinegar may be added in a quantity ranging from 0,5% to 6% in respect to the weight of the textile material, depending on some dyeing requirement, to be determined by sperimental tests.

[0024] In a third step F3, the textile material is immersed or dipped into the hot dyeing-bath, which is maintained in agitation or stirred condition by appropriate stirring means and/or hot water jets, superheated water, and/or steam, and/or by the movement of the textile material, so as to allow soaking of the textile material with the aqueous solution of the dyeing-bath, and the dissolved ethyl alcohol. Depending on the type and quantity of the textile material, the time required for soaking, generally is ranging from 3' to 15'.

[0025] After the soaking of the textile material, there is a fourth process step F4 during which at least one colouring substance or agent is gradually added and mixed into the dyeing-bath; during mixing, the colouring agent rapidly and evenly is diffusing through the bath and into the textile material thanks to the presence of the ethyl alcohol.

[0026] According to a relevant feature of the invention, it has been found, in fact, that the use of ethyl alcohol as colour dispersing agent, in substitution of the dispersing agents, levelling agents and anti-rope agents usually used in a conventional dyeing process, in addition to not being pollutant, acts as an excellent dispersing and levelling agent providing, in combination with acetic acid or wood vinegar, a substantive contribution for fixing the colouring agent to the fibres of the textile material.

[0027] In order to facilitate the soaking of the textile material and an even dispersion of the colouring substance in the dyeing-bath, the latter is maintained at a constant temperature equivalent to or close to the temperature at which the bath has been heated for mixing and dissolving the ethyl alcohol, the sodium salt, the acetic acid and the colouring agent, while maintaining agitation or a stirred condition for a period ranging, for example, from 3' to 15'.

[0028] Subsequently, during a fifth step F5, the dyeing-bath is further heated to a second temperature close to or equivalent to the boiling temperature, depending on the pressure condition of the same bath.

[0029] Whenever the dyeing step takes place at ambient pressure, the second temperature of the bath will preferably range from 95° to 98°C, while whenever the dyeing phase takes place under pressure condition, said temperature will depend upon the pressure values used in the process, with a consequent reduction in the time necessary for dyeing.

[0030] During a sixth step F6, the textile material is maintained in the heated dyeing-bath at the aforesaid second temperature, in an agitation state, for a period long enough to cause a complete and even colouring of the textile material; in fact, during this step, the colouring agent completely disperses and fixes to the textile material, thanks to the combined action of the ethyl alcohol, the high temperature and the sodium salt.

[0031] From tests carried out on some samples of fabric, it was found that the time necessary for maintaining the textile material in the dyeing-bath at a temperature close to or equivalent to the boiling temperature, for a complete dyeing, was much shorter than that of a conventional dyeing-bath, for example lower than 60', preferably ranging from 15' to 40', thereby resulting in a considerable reduction of the time necessary for the dyeing, compared to a conventional processes in which the time required for maintaining the textile material in the high-temperature bath, is about two or more hours.

[0032] Upon completion of the dyeing step F6, a sample is taken from the dyed textile material, step F7, to ensure that the colour acquired by the same material possesses all the required characteristics, in terms of shade and uniformity of colouring.

[0033] If the textile material comes up to the expected

qualitative standards, an eighth step F8 is carried out in which the textile material is washed to rid the fibres of the excess of colouring agent, in order to complete the dyeing process. This step involves carrying out a limited number of washes, such as one or two washes depending on the type of colouring agent and the intensity of the colouring required; conversely in a conventional dyeing process four or more washes are usually required to remove the excess of colouring agent.

[0034] This reduction in the number of washes makes it possible to reduce the dyeing cycle time, and to save a considerable amount of water, with a consequent reduced impact on the environment, and low costs.

[0035] Whenever the tested sample of the dyed textile material reveals characteristics in terms of colouring which do not meet the pre-established standards, a ninth step F9 can be carried out in which a further metered quantity of colouring agent and/or ethyl alcohol, and the previously mentioned colour dispersing and/or fixing agents, are added and mixed into the dyeing-bath so that, by maintaining the textile material in the dyebath at the said second temperature and for a necessary length of time, the colouring characteristics can be modified and/or corrected to attain the required colouring degree.

[0036] The sampling of the dyed textile material is then carried out again to ascertain whether it is necessary to repeat the step F9 or whether the textile material possesses the required colouring characteristics, and the process can consequently go on to the final washing step F8.

[0037] In order to obtain good quality dyeing, the quantity of ethyl alcohol to be mixed into the dyeing-bath can for example be equal to or less than 6 cc/l, preferably from 0,4 cc/l to 6 cc/l in respect to the volume of the water solution. These values refer to ethyl alcohol in the absolute state, and may be changed according to the intensity of the colour to be reproduced and to the type of the colouring agent used in the dyeing process. The ethyl alcohol can, however, be mixed with the dyeing-bath in any diluted form, in order to have, for example, less difficulty in metering the latter.

[0038] The dyeing process according to the invention can be applied to any textile material in the form of loose fibres, for example in staple, continuous filaments, in tops, yarns wound for example on reel or hank, woven or non-woven fabrics, and the like.

[0039] In order to check the characteristics of the textile materials dyed with the process according to the invention, experimental tests have been carried out on fabrics dyed in various colours; samples of dyed fabrics were analysed in accordance with the IWS Standards, by Biella Qualità Totale s.r.l. laboratory in Salussola (Biella) which is accredited by the National Laboratory Accrediting System.

[0040] In particular, the following tests were carried out on samples of wool and wool/silk fabric dyed with the process according to the invention:

A- light-fastness test: the test was carried out in accordance with the UNI Standard 7639/1989 method I, with rating on the blue scale, with a maximum temperature of 45°C and 50% of moisture; a light fastness index equivalent to 4 was observed on a blue sample in wool, and 5 on a brown sample in wool/silk;

B- acid sweat-fastness test: the test was carried out in accordance with UNI EN ISO Standard 105 E04/98, on 2DW multi-fibre fabric with applied load of 5 Kg, at 37±2°C for 4 hours; a fastness index equivalent to 5 was observed on both the blue and the brown samples;

C- alkaline sweat-fastness test: the test was carried out in accordance with UNI EN ISO Standard 105 E04/98, IWS TM 174/00, on 2DW multi-fibre fabric with applied load of 5 Kg, at 37±2°C for 4 hours; a fastness index equivalent to 5 was observed on both the blue and the brown samples;

D- dry rubbing-fastness test: the test was again carried out in accordance with UNI EN ISO Standard 105 X-12, with a number of revolutions equivalent to 10, on woven material against a control piece of dry cotton, with a load of 9N; a fastness index equivalent to 4/5 was observed on both the blue and the brown samples;

E- wet rubbing-fastness test: the test was carried out in accordance with UNI EN ISO Standard 105 X-12, with a number of revolutions equivalent to 10, on woven material against a pad of damp cotton, with a load of 9N; a fastness index equivalent to 3/4 was observed on both the blue and the brown samples.

[0041] The results of the tests carried out, therefore show high colour fastness values for fabrics dyed in a bath containing an extremely low quantity of ethyl alcohol, as specified, and consequently non-polluting percentages, thereby confirming the efficiency of the dyeing process according to the invention.

[0042] The process according to the invention, in addition to allow a considerable reduction in costs due to the aforementioned reduction in dyeing times and the lower consumption of water, enables excellent results in the dyeing of the textile materials.

[0043] Moreover, compared to a conventional process, the process according to the invention reduces environmental pollution in that by using ethyl alcohol in the dyeing-bath it is possible to eliminate all the usual additives such as the surfactans, conventional acids or fixing agents which are highly pollutant and therefore also entail high purification costs. On the contrary, the ethyl alcohol, in the low percentages that remain in the dyeing-bath upon completion of the process, has a negligible

effect on the environment.

[0044] By eliminating the use of farmful acids of the conventional dyeing process, and their substitution with acetic acid or wood vinegar, it is also possible to improve the working conditions of the human operators, and eliminate the risks of burns for contact with the acids; in addition, the exhaust fans usually installed in dyeing plants are capable of eliminating most of the ethyl alcohol vapours during the dyeing process.

[0045] The process for dyeing textile material according to the invention, can be carried out either in a discontinuous or a continuous form.

[0046] An example of a plant for carrying out the process for dyeing textile material according to the invention, in a discontinuous form, is shown in figure 2 which illustrates the dyeing of fabric pieces sewn together to form a closed ring. In particular, the apparatus comprises a dyeing basin 10 containing the dyeing-bath, which is heated by letting in hot water and/or steam produced by a heat exchanger 11. It also comprises a first tank 12 for the introduction of a colouring agent into the dyeing-bath, and a second tank 13 for the introduction of a metered quantity of ethyl alcohol; salt and acetic acid may be added manually or by apposite tanks.

[0047] The fabric 14 is made to move forward in the dyeing-bath by means of a rotary reel 15 which imparts a circulatory movement to the fabric ring 14. In particular, the reel 15 collects the fabric 14 from one end of the dyeing basin 10 and moves it into a dyeing channel 16, through which flows a stream of hot water which entraines the fabric 14, thereby enabling it to be re-introduced into the bath at the other end of the basin 10.

[0048] The flow of water in the channel 16 is fed by a pump 17 which can also produce jets 18 of hot water in the dyeing basin 10, in order to maintain the dyeing-bath in agitation or stirred state.

[0049] The dyeing apparatus can also comprise means for recovering the ethyl alcohol from the vapours emitted by the dyeing-bath, so as to limit consumption and dispersion into the work environment.

[0050] Said means for recovering the ethyl alcohol comprise a suction device 19 for sucking the vapours from the dyeing basin 10, and a condensation system 20 for recovering the ethyl alcohol from the vapours of the dyeing-bath.

[0051] The process for dyeing textile material can be carried out also in a continuous form, for example, with a dyeing apparatus in which a fabric of indefinite length, for example a strip of fabric, is unwound from a roller, made to pass through a hot dyeing-bath containing a colouring substance and the ethyl alcohol according to the invention and then cooled, washed in separate tanks dried, and lastly rewound onto a roller.

[0052] What has been described and shown with reference to the accompanying drawings, has been given purely by way of example in order to illustrate the general features of the invention, as well as several of its preferential embodiments; consequently, other modifications or changes to the process for dyeing textile material are possible, and the use of any type of plant without thereby departing from the scope of the claims.

Claims

1. A process for dyeing textile material in a dyeing bath comprising a colouring agent, as well as a colour dispersing agent and a colour fixing agent, as dye assisting agents, in a heated water solution, and in which the textile material is dipped into a headed dyeing bath maintaining the textile material in a dipped condition for a length of time, **characterized by** mixing a metered quantity of ethyl alcohol, as colour dispersing agent, during heating of the dyeing bath.

2. A process for dyeing textile material, according to claim 1 **characterized by** steps of:

   pre-heating and maintaining the dyeing bath at a first temperature during mixing of the ethyl alcohol,
   soaking the textile material into the dyeing bath while maintaining the same dyeing-bath at said first temperature;
   mixing and dissolving the colouring agent; and subsequently heating the dyeing bath for dyeing the textile material, at a second higher temperature, close to the boiling temperature of the bath.

3. A process for dyeing textile material, according to claim 2, **characterised in that** said first temperature is lower than the boiling temperature of the ethyl alcohol.

4. A process for dyeing textile material, according to claim 2, **characterised in that**, said first temperature is ranging from 50° to 70°C.

5. A process for dyeing textile material, according to claim 2, **characterised in that** said first temperature is ranging from 55° to 65°C.

6. A process for dyeing textile material, according to claim 1, **characterised in that** the dyeing of the textile material takes place at ambient pressure.

7. A process for dyeing textile material, according to claims 2 and 6, **characterised in that** the second temperature is ranging from 95° to 98°C.

8. A process for dyeing textile material, according to claim 1, **characterized in that** the dyeing phase of textile material takes place under pressure condition.

9. A process for dyeing textile material, according to claim 1, **characterised in that** the dyeing-bath has a PH value ranging from 5 to 7.

10. A process for dyeing textile material, according to claim 2, **characterised by** maintaining the textile material in the dyeing-bath at said second temperature, for a period of less than 60'.

11. A process for dyeing textile material, according to claim 10, **characterised in that** the textile material is maintained in the dyeing-bath for a time ranging from 15' to 40'.

12. A process for dyeing textile material, according to claim 1, **characterised by** mixing ethyl alcohol in the dyeing-bath in a quantity of less than 6 cc/l in respect to the volume of dyeing-bath.

13. A process for dyeing textile material, according to claim 12, **characterised in that** said quantity of ethyl alcohol mixed in the dyeing-bath is ranging from 0,4 to 5 cc/l in respect to the volume of the dyeing bath.

14. A process for dyeing textile material, according to claim 1, **characterised in that** the ethyl alcohol is mixed in the absolute state.

15. A process for dyeing textile material, according to claim 1, **characterised in that** the ethyl alcohol is mixed in diluted form.

16. A process for dyeing textile material, according to claim 1, **characterised in that** the textile material is in a form selected from: loose fibres, continuous filaments, yarn, woven and non woven tissue.

17. A process for dyeing textile material, according to claim 1, **characterised in that** the dyeing of the textile material is carried out in a discontinuous form.

18. A process for dyeing textile material, according to claim 1, **characterised in that** the dyeing of the textile material is carried out in a continuous form.

19. A process for dyeing textile material, according to claim 1, **characterised by** repeating the mixing of ethyl alcohol and/or colouring substance, at least once.

20. A process for dyeing textile material according to claim 1, **characterized by** mixing a metered quantity of a sodium salt in the dyeing bath.

21. A process for dyieng textile material according to claim 20 **characterised in that** the sodium salt is selected from sodium sulphate and sodium cloride

22. A process for dyeing textile material according to claim 20, **characterized in that** the sodium cloride salt is mixed in a quantity ranging from 2% to 40% in respect to the weight of the textile material.

23. A process for dyeing textile material according to claim 20, **characterized in that** the sodium salt is mixed in a quantity ranging from 5% to 20% in respect to the weight of the textile material.

24. A process for dyeing textile material according to claim 1, **characterized by** mixing a metered quantity of acetic acid as colour fixing agent, ranging from 0,5% to 6% in respect to the weight of the textile material.

25. A dyeing-bath for textile material comprising a colouring agent, a colour dispersing agent and a colour fixing agent, **characterised in that** said colour dispersing agent is ethyl alcohol.

26. A dyeing-bath, according to claim 25, **characterised in that** the ethyl alcohol is mixed in the dyeing-bath in a quantity ranging from 0,4 cc/l to 6 cc/l in respect to volume of the dyeing bath.

27. A dyeing-bath for colouring textile material, according to claim 21, **characterised by** a pH value ranging from 5 to 7.

28. A dyeing bath according to claim 24 **characterized by** comprising a sodium salt selected from sodium cloride and sodium sulphate salt.

29. A dyeing bath according to claim 24, **characterized by** comprising a colour fixing apart in the form of acetic acid.

30. A textile material dyed by means of the dyeing process according to claim 1, **characterised in that** said textile material is in a form selected from: loose fibres, continuous filaments, yarn, fabric, woven and non woven tissue.

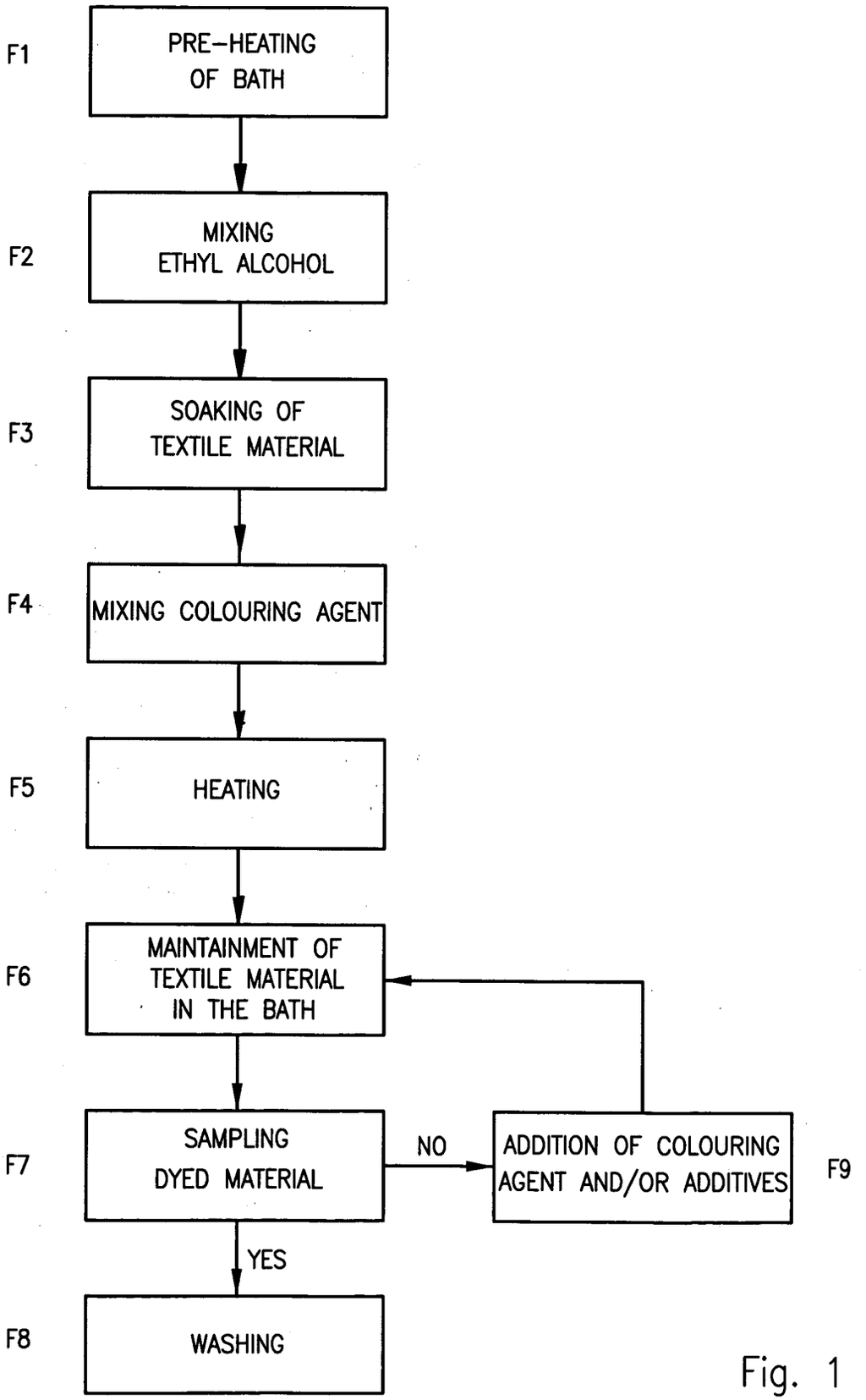
F1
PRE–HEATING OF BATH
F2
MIXING ETHYL ALCOHOL
F3
SOAKING OF TEXTILE MATERIAL
F4
MIXING COLOURING AGENT
F5
HEATING
F6
MAINTAINMENT OF TEXTILE MATERIAL IN THE BATH
F7
SAMPLING DYED MATERIAL
NO
ADDITION OF COLOURING AGENT AND/OR ADDITIVES
F9
YES
F8
WASHING

Fig. 1

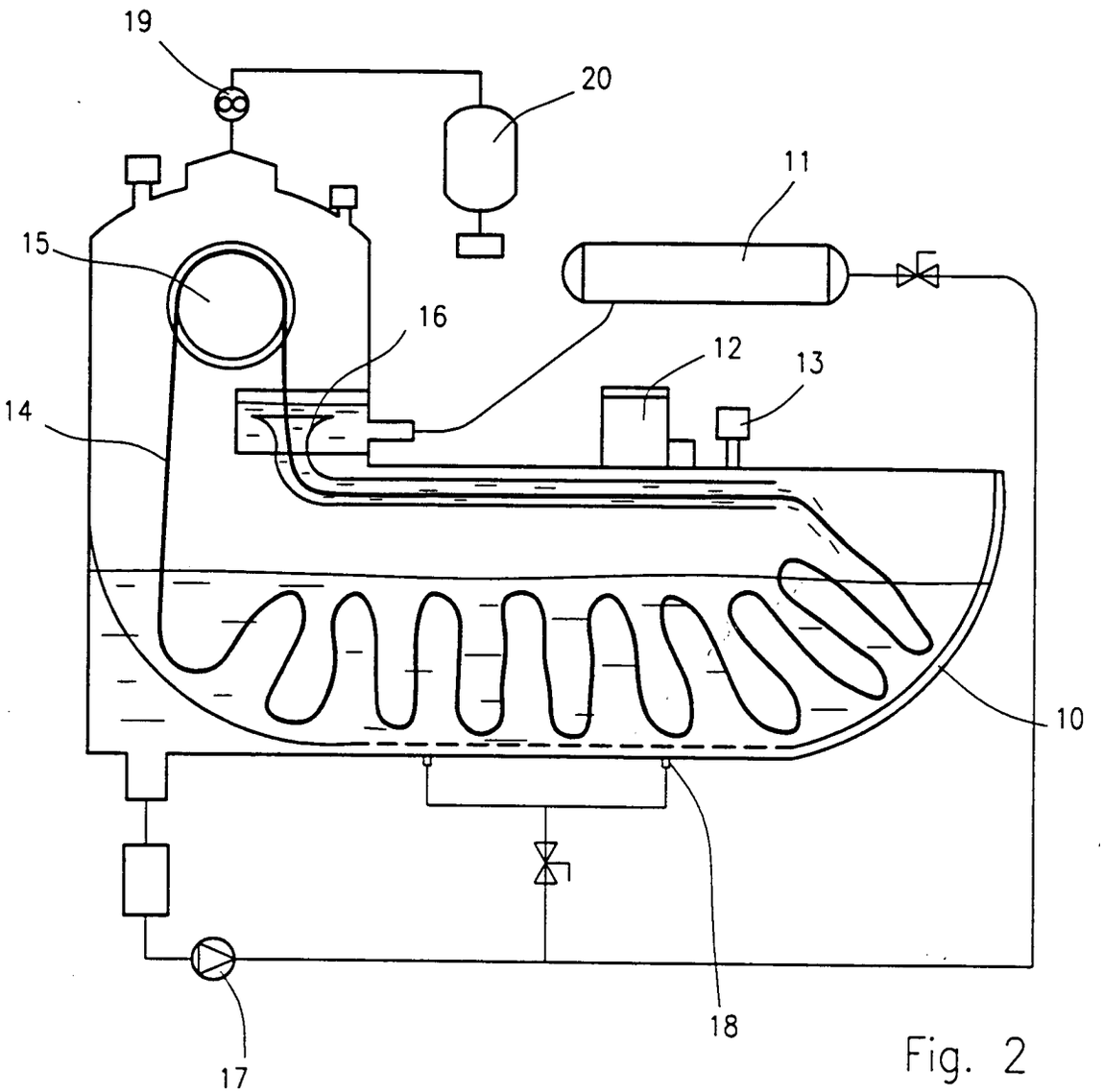

Fig. 2