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(54) Animal fibre processing.

(57) The invention provides an apparatus for processing wool and a corresponding solvent process utilizing the apparatus. The apparatus includes an inlet (2) for the admission of raw (greasy) wool, and a first bowl (3) to which wool is first admitted. Wool in first bowl (3) is wet, as by solvent spray from nozzle (11) and falls into a solvent bath (13). An endless belt (5) transports wool through solvent bath (13) in bowl (3). A co-flow of solvent through nozzle (14) is utilized to ensure that wool disposed on belt (5) travels at the same speed as the belt (5). A pressurized spray from shower device (7) is directed to wool on belt (5) to cleanse same. Wool treated in first bowl (3) is carried on an elevated portion of belt (5) where it is subjected to a cascade of solvent from weir (8). Wool is carried out of bowl (3) into bowl (4) by falling from the upper extremity of belt (5) in the vicinity of roller (17). This wool is then carried by endless belt (6) for a second cleansing treatment. Co-flow of solvent is introduced into bowl (4) through nozzle (15). A shower of solvent is provided through shower device (9). Endless belt (6) has an elevated portion between rollers (18) and (19). Wool carried on this elevated portion of belt (6) is treated to a cascade of pure solvent from weir (10). Wool is carried from bowl (4) to a centrifuge for drying.

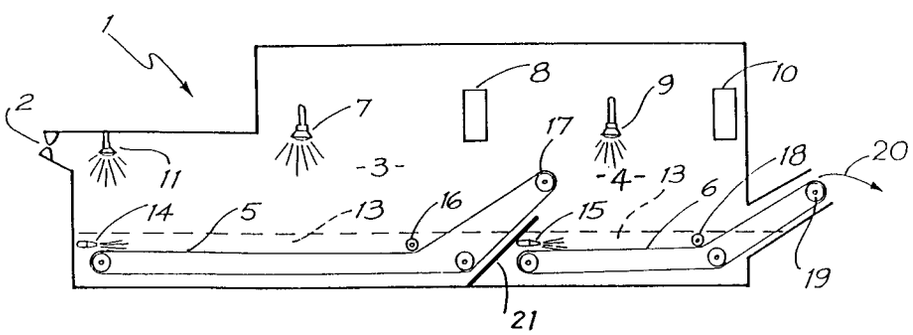

FIG. 1

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This invention relates to animal fibre, particularly wool, processing, and more particularly to apparatus and a process using that apparatus whose purpose is to produce a fine wool product of greater fibre strength and length than is available by use of conventional wool water based cleaning and scouring processes, the process being environmentally advantageous.

Production of a wool of optimum strength and fibre length after cleaning and scouring is obviously desirable.

Australian patent No. 615559 (38301/89) discloses a water free organic solvent related process for treatment of raw wool which results in an improved fine wool product. The said patent discloses, with particular reference to Fig. 3 thereof, an apparatus in which the process disclosed in that patent is carried out. In particular, this apparatus includes a conveyor having a pair of head rollers and a pair of tall rollers. Fleeces in the form of greasy wool are placed tip down in baskets carried by the conveyor. These baskets are serially conveyed to a tip pre-treatment zone in a scouring tank. The tips only of the fleeces are subjected to gentle cleaning action in the pre-treatment zone. The remainder of the fleece (apart from the tip portion) does not contact the organic solvent scouring medium in the tank pre-treatment zone.

After passing through the tip pre-treatment zone of the scouring tank, the fleeces are removed from the solvent solution to allow solvent attached to the fleece tips to drain back into the first tank portion which is separated from the second tank portion by a baffle plate.

Most of the dirt and other foreign material found in raw wool is located in the tip region and the prior art process had as one of its objects an initial tip cleansing process step.

The fleece is thereafter fully immersed in the second tank portion for a preferred period of 6-10 minutes. After this immersion the treated fleece is removed from the scouring tank, may then be rinsed by a fresh solvent and is unloaded into a centrifuge for drying purposes.

The system of Australian patent No. 615559 is a marked improvement over previously known treatment systems for raw wool, producing treated wool of good fibre length and strength.

However, it is felt that the said system may be further improved upon. For example, the system requires extraction from a wool bale of a quantity of wool sufficient to occupy a basket which carries the wool to the pre-treatment zone. It also requires that this wool be presented in in tip-down configuration. This is a time consuming, labour intensive and costly exercise.

Further, the known solvent system was not sealed, resulting in admission or escape of solvent vapours into the workplace with consequent loss of solvent which required constant replacement.

It is therefore an object of this invention to provide an improved wool processing system and apparatus.

This invention in one broad form provides apparatus for processing animal fibre, particularly raw wool, said apparatus comprising a solvent bowl; means for admitting said fibre to said solvent bowl, an endless belt in said solvent bowl adapted to transport fibre through said bowl, one or more solvent shower devices disposed in said bowl adapted to spray solvent under pressure to cleanse said fibre as said fibre traverses said bowl on said endless belt, and a weir adapted to receive at least substantially pure solvent and cascade said solvent into said bowl on an elevated portion of said endless belt out of contact with solvent in said bowl.

The above embodiment of this invention utilizes a single bowl and is appropriate where wool to be processed is not particularly greasy as is the case, for example, with greasy merino wool. To process such greasy merino wool it is preferable to use a two or more bowl apparatus and the preferred embodiment of this invention will be described with reference to a two bowl apparatus.

Thus, this invention in a further broad form provides apparatus for processing raw (greasy) wool, said apparatus comprising:

a first solvent bowl having an entry end and an exit end;

means to convey raw wool into the entry end of said bowl;

a first endless belt in said first bowl adapted to transport wool through said first bowl;

one or more first bowl solvent shower devices adapted to spray solvent under pressure to cleanse said wool as said wool is carried by said first bowl endless belt;

a second bowl having an entry end and an exit end with a second endless belt adapted to convey wool through said second bowl;

one or more second bowl solvent shower devices adapted to spray solvent under pressure to further cleanse said wool as it traverses said second bowl;

first weir means adapted to receive solvent from said second bowl and cascade said second bowl solvent over wool on an elevated portion of said first endless belt out of contact with solvent in said first bowl;

second weir means adapted to receive pure solvent and cascade said pure solvent over wool disposed on an elevated portion of said second endless belt out of contact with solvent in said second bowl;

said first endless belt being adapted to convey said wool to the exit end of said first bowl for entry to the entry end of said second bowl.

It will be appreciated that wool entering said first bowl through said rollers is comparatively dry and it is preferred that a first immersion spray of solvent be addressed to the incoming wool to wet the wool sufficiently to allow the wool to sink through the first bowl solvent bath to ride on the first endless belt. Spraying from the first bowl solvent shower device(s) is effected when the wool is immersed in solvent bath in the first bowl.

Immersion of the wool in the first bowl for a period of 1-2 minutes before showering has the effect of loosening grease and dirt to a sufficient degree to allow spraying and eventual cascading from said first bowl weir to remove up to 95% of the dirt loading of the raw wool and up to 80% of the grease. The second bowl will remove most If not all of the remaining dirt and almost all the remaining grease.

It is believed that approximately only 0.2% of grease will remain in the wool exiting the second bowl, which is a most acceptable level by industry standards.

Overall it is desirable to limit immersion of the wool in the first and second bowls (in total) to no more than 15 minutes and preferably no more than 10 minutes. To reduce immersion times, heat may be applied to the solvent in the first bowl (or this may arise from the solvent pumping process) so that solvent temperature in the first bowl is approximately 40 ° C. Further, ultrasonic energy may be introduced to the first bowl solvent at a power level of approximately 25 KHz. First bowl immersion time approximates 4-5 minutes and second bowl immersion time 2-3 minutes in the most preferred form of the process of this invention.

A still system is provided for solvent utilized in the process of this invention with a view to preserving such solvent and to clean recovered solvent for re-use in the process.

A clean solvent tank (reservoir) is provided with a sufficient supply of solvent to operate the system. Solvent from the reservoir is first piped into the weir device of the second bowl, and thence cascades into the second bowl as immersion solvent for the wool traversing this bowl. Solvent from the second bowl, obviously containing a quantity of grease and dirt is then piped to the weir device into the first bowl, displacing dirty solvent in wool on the elevated endless belt exit portion of the first bowl as it cascades into the first bowl.

Solvent from the first bowl is piped to the front or wool loading end of the apparatus to produce initial solvent flow (co-flow) to conduct wool along the first endless belt at a desired rate which is substantially identical to the rate of belt travel. Further solvent from the first bowl is piped to provide the wetting (or dunking) for the wool as it enters the apparatus to ensure the wool will ride on the first endless belt rather than floating on the solvent surface.

Further, some second bowl solvent is piped to the second bowl shower device. A further proportion of second bowl solvent is used as co-flow for the second bowl. Again some first bowl solvent is piped to the first bowl shower arrangement (spray manifolds).

Used solvent from the first bowl is conducted away to a distillation system (stills) at the same rate as clean solvent is introduced to the second bowl weir. Between the first bowl and the first still is a series of filters adapted to extract foreign matter other than grease from the used solvent. This foreign matter is conducted to a collection chamber and is disposed of in powder form. The used solvent is admitted to the first still where it is boiled under partial vacuum. Vapour is conducted from this first still in condensed form which is then sufficiently pure for readmission to the system over the cascade into the second bowl.

The remaining stills also produce clean solvent and are effective to concentrate the grease which may be collected as wool grease and used as a source of lanolin and other products.

Vegetable matter such as burrs and grass seeds remaining in solvent laden wool leaving the second bowl and admitted to a centrifuge to recover 98-99% of the solvent, may be carded out by conventional carding systems.

In an exemplary system according to this invention, which cleans wool without tangling the same, the following solvents are examples of those which might be used:

Solvent	Boiling Point	Specific Gravity
1,1,1 trichloroethane	74 ° C	1.34
trichloroethylene	87 ° C	1.49
methylene chloride	39 ° C	1.36
perchloroethylene	121 ° C	1.63

Other suitable solvents are well known to the man skilled in the art.

The following further features are typical:

First bowl immersion depth approximately equal to the total length of the greasy wool staple which for pure merino wool is in the range 75-150 mm; belt speed 2-4 m/min; a sensor system adapted to maintain solvent bath level in first and second bowls substantially at the chosen immersion depth; belt loading density 2-3 kg/m^2; co-flow at a rate to move the wool at the same rate of movement as the belt; pressure up to 100 p.s.i. and flow from shower(s) in first bowl 50-100,000 l/hr, i.e. at appropriate rates to dislodge grease and dirt from the soaked wool without tangling the wool; belts in first and second bowls are mesh type with clear opening of 2 mm to 4 mm square to allow solvent to pass through the belts; (for optimum results the disturbance in the solvent bath occasioned by the solvent shower and reflection of solvent from the belt should be such as to ensure maximum removal of dirt and grease from the wool without tangling the same. The man skilled in the art will appreciate that adjustments might need to be made to belt material, belt travel and co-flow rates, shower pressure and flow rate to accommodate different varieties and qualities of wool or other fibre); cascade into first bowl at 5,000 l/hr for processing 750 kg of greasy wool per hour (substantially the same as distillation rate and cascade rate into second bowl); second bowl rates substantially identical with first bowl rates; further filtration of solvent in the second bowl for finer particle removal is also preferred to remove remaining dirt and suint (water soluble salts of the sheep's sweat glands). This filtration is effected between the bowl solvent and the shower device to ensure shower solvent is as clean as possible. Corresponding filtration is effected in the first bowl between the bath (bowl) and the shower device.

By way of example, one embodiment of wool processing apparatus according to this invention will now be described with reference to the accompanying drawings, wherein:

Fig. 1 is a section of wool processing apparatus according to one embodiment of this invention;

Fig. 2 is a schematic diagram of the process of this invention.

In the drawings, apparatus generally depicted at 1 includes entry rollers 2 through which wool conveyed to the apparatus of this embodiment of the invention, for example by an endless belt conveyor, is admitted to first bowl 3. The level of solvent 13 in first bowl 3 and second bowl 4 is depicted by broken line. Bowls 3 and 4 are divided by partition 21. Some of the solvent 13 in bowl 3 is utilized as a wetting or dunking liquid, being piped to outlet 11 once it is readmitted to bowl 3 to wet incoming wool shortly after that wool traverses rollers 2. Incoming wool so wetted falls to the surface of endless belt 5 in first bowl 3 and is carried along belt 5 at a predetermined rate, some of the solvent 13 in bowl 3 being conducted to outlet 14 once it is forced to flow into the region of endless belt 5 where wool admitted to bowl 3 falls onto that belt, this co-flow of solvent through outlet 14 being conducted to ensure that wool is conducted along belt 5 at the rate of travel of the belt. A further portion of solvent 13 in bowl 3 is conducted through a filter (not shown) to shower device 7 whence it is forced vertically downwards to mix with solvent 13 to remove grease and foreign materials from the wool being transported along endless belt 5. Endless belt 5, and wool transported thereon, rises above the surface of solvent 13 between belt rollers 16 and 17 and in this region is washed by solvent 13 conducted from second bowl 4 over weir 8 to further remove grease and foreign matter in this wool.

Wool so washed is conducted over endless belt 5 as it traverses roller 17 and then falls onto endless belt 6 in second bowl 4. Some of the solvent 13 in second bowl 4 is used as co-flow liquid through ejector 15. A further portion of solvent 13 is conducted via a filter (not shown) to shower device 9 whence it is transmitted under pressure vertically downwards to mix with solvent 13 in the region of endless belt 6 to further remove grease and foreign matter from wool carried by endless belt 6. A portion of endless belt 6 rises above the level of solvent 13 in bowl 4 between rollers 18 and 19 and wool carried on this portion of belt 6, above the general level of solvent 13 in bowl 4, is washed by pure solvent admitted to bowl 4 through weir 10. Wool so washed is carried by endless belt 6 over roller 19 to exit the apparatus 1 in the direction of arrow 20 being thereafter conducted to a centrifuge where remaining solvent mixed with the wool is extracted and conducted as a vapour (or in part vapour, part liquid form) for eventual return to the original pure solvent reservoir (see Fig. 2) for return to the apparatus of Fig. 1. As best illustrated in the schematic drawing of Fig. 2, the system of this embodiment of the invention is sealed and solvent is recirculated In the system, solvent being removed from bowl 3 at substantially the same rate as pure solvent is admitted to bowl 4 via weir 10, the system being such that the level of solvent 13 in bowls 3 and 4 is maintained substantially constant.

In Fig. 2, pure solvent is pumped from the solvent reservoir to bowl 4 entering bowl 4 over weir 10 (Fig. 1) as a final wool rinse before wool is admitted to the cartridge. As indicated above, some of the solvent in bowl 4 is passed through a filter and readmitted to bowl 4 through shower 9. Solvent used in bowl 4 is transferred to bowl 3 via weir 8. Some of the solvent in bowl 3 is again filtered to be readmitted to bowl 3 through shower 7. Used solvent is conducted from bowl 3 through a series of filters. From these filters

foreign material is conducted via a dirt drier to a foreign material collection chamber where it is collected in powder form. Further dirt from the shower filters is also transferred to this series of filters. Solvent and grease is conducted from these filters to a series of stills whence the grease is extracted and is collected in one or more collection tanks. In the stills, solvent is boiled off from the solvent and grease mixture and such vaporized solvent is condensed and returned to the solvent reservoir. Solvent from the dirt drier is also transferred to the solvent reservoir. Vapours from bowls 3 and 4 is conducted to a refrigerated condenser and the pressure in bowls 3 and 4 is maintained at slightly less than normal air temperature in order to create a force to conduct those vapours to the condenser. Vapours from the centrifuge and dirt drier are also conducted to the condenser whence solvent is returned to the pure solvent reservoir for recirculation in the system.

The whole system is sealed and is under a negative pressure to prevent escape of vapours to the atmosphere. In this regard a vapour recovery unit is utilized to which vapours in the system are drawn under negative pressure. These vapours are condensed and transferred to the clean solvent reservoir for re-use in the system. A final vapour trap is used in the form of a carbon-activated adsorption unit to ensure vapour emissions are compatible with the most stringent environmental guidelines.

In practice it has been found that there is some minimal loss of solvent in that the wool grease extracted from the system has an approximate 2% solvent content. This, in addition to any minor vapour escape is the sum total of solvent loss which is expected to range from 70 to 100 kg per day. This is considered entirely acceptable given the system is designed for a wool feed rate of 750 kg (greasy) per hour and a solvent distillation rate of 6500 kg/hour.

It is contemplated that a constant 5000 litres per hour inflow of clean solvent into second bowl 4, be maintained, this inflow being balanced by an outflow from the second bowl 4 to the first bowl 3 of approximately 5000 litres per hour. The wet wool entering the second bowl from the first bowl will also carry with it some solvent, so the flow back to the first bowl will actually be greater than the 5000 litres per hour, by the amount carried forward with the wet wool. The return flow to the first bowl 3 is taken from the second bowl 4 jetting circulation flow, via the appropriate control valve. A level controller will sense solvent level in the second bowl 4 and spill enough solvent back to the first bowl 3 via that control valve to balance the net inflow and maintain a constant solvent level.

The 5000 litres per hour solvent flow from the scour apparatus enters a primary still which operates below atmospheric pressure. In order to maintain a constant 30% wool grease concentration in the primary still, a constant bleed of approximately 330 kg/hour is taken from a boiling bath via the primary still grease extraction pump and sent to the secondary still. The recondensed clean solvent liquid is then pumped via the primary still solvent extraction pump to the clean solvent tank.

In a secondary still, the liquid from the primary still is concentrated up to 80% grease concentration. A flow of 120 kg/hour is removed from the boiling bath via the secondary still grease extraction pump and sent to the tertiary still. The recondensed clean solvent liquid is pumped via the secondary still solvent extraction pump to the clean solvent tank.

In the tertiary still, the bath is heated electrically, and the solvent vapour is removed from the still by an injector pump immersed in a bath of cold solvent at atmospheric pressure. The bath is cooled by refrigeration and condenses the solvent vapour within the bath. This causes the bath level to rise, with the solvent overflow going to the clean solvent tank. Hence no tertiary solvent liquid extraction pump is required.

From the clean solvent storage tank, a constant 5000 l/hr of solvent is pumped back to the second bowl 4 by the clean solvent pump. The level in the clean solvent tank is controlled by a level controller. If the tank level falls, due to flowback from the scourer being less than the flow pumped to the scourer (resulting from solvent losses) the solvent makeup pump will pump additional solvent from the solvent dump tank into the primary still.

In the case of a rise in level in the clean solvent tank, the excess will simply spill via an overflow back to the solvent dump tank.

The wool grease is progressively concentrated in the residues from the stills, to over 95% grease concentration in the discharge from the final still.

Considerable energy is added to the circulating solvent by the various pumps in the system. These pumps include jetting circulation pumps, co-flow pumps and the solvent and grease extraction pumps. In order to prevent excessive temperature rise of the solvent in the bowls 3 and 4, a refrigerated coiling cool is fitted in each bowl, preferably in the jetting area below the return bowl. Refrigeration may be supplied to this coil from the main still refrigeration unit and bowl temperature may be readily adjusted by a simple dial thermostat.

Vapour control is an important preferred feature of the system the subject of this invention. All solvent-containing items, such as the scour apparatus (3, 4) filters, tanks, centrifuges, etc are maintained under a slight negative pressure. This will cause a small air inflow at any leaks, rather than an outflow of air/solvent vapour, preventing unintentional solvent vapour loss. To maintain the desired negative pressure, a small fan is connected on its suction side to all solvent-containing items. The solvent-laiden air discharged from the fan will be taken to a vapour recovery system, using a combination of refrigerated and carbon absorption vapour recovery. A refrigerated system to cool the solvent-laden vapour to approximately -30 ° C may be provided. The solvent vapour would, after cooling, be reheated to ambient temperature. During the cooling phase, solvent vapour will be condensed, leaving only approximately 4% vapour in the air. This stream will then be passed into a relatively small and comparatively inexpensive carbon absorption system, capturing approximately 98% of the remaining solvent vapour and thus cutting solvent vapour emmission losses to the order of 17 kg/day. Discharge from the vapour recovery system is taken outside the building in which the system is housed and discharged via an exhaust stack.

Thus the entire system is environmentally acceptable in that little or no solvent escapes the system, all foreign material is removed from the wool and collected, particulate matter as dirt which might be useful as a fertilizer, the grease for further processing as described above, vegetable matter in subsequent conventional processes. The products of the system are thus clean untangled high quality wool, powdered dirt and a higher recovery wool grease than results from conventional water scour processes. Water scour grease dirt and protein waste products are usually licensed for admission as pollutants to e.g. river systems. The current system will obviate this undesirable situation.

Claims

1. Apparatus for processing animal fibre, particularly raw wool, said apparatus comprising a solvent bowl; means for admitting said fibre to said solvent bowl, an endless belt in said solvent bowl adapted to transport fibre through said bowl, one or more solvent shower devices disposed in said bowl adapted to spray solvent under pressure to cleanse said fibre as said fibre traverses said bowl on said endless belt, and a weir adapted to receive at least substantially pure solvent and cascade said solvent into said bowl on an elevated portion of said endless belt out of contract with solvent in said bowl.

2. Apparatus as defined in claim 1 further comprising a solvent outlet adapted to dispense solvent to wet fibre entering said bowl.

3. Apparatus as defined in any one of the preceding claims further comprising a solvent co-flow outlet adapted to introduce solvent under pressure into said solvent bowl in a location to force fiber located on said endless belt in the vicinity of the fibre entry end of the bowl, to ride said endless belt towards the fibre exit end of the bowl.

4. Apparatus as defined in any one of the preceding claims further comprising a bowl filter adapted to receive a predetermined quantity of solvent from said solvent bowl to filter said solvent and return said solvent in substantially pure form to said one or more shower devices.

5. Apparatus as defined in any one of the preceding claims further comprising a bowl exit region through which wool cleansed in said bowl may be conducted to a centrifuge, said bowl exit portion being located adjacent the upper reach of said elevated endless belt portion.

6. Apparatus as defined in any one of the preceding claims further comprising a solvent reservoir from which pure solvent may be directed for admission to said bowl over said weir.

7. Apparatus for processing raw (greasy) wool, said apparatus comprising:

a first solvent bowl having an entry end and an exit end;

means to convey raw wool into the entry end of said bowl;

a first endless belt in said first bowl adapted to transport wool through said first bowl;

one or more first bowl solvent shower devices adapted to spray solvent under pressure to cleanse said wool as said wool is carried by said first bowl endless belt;

a second bowl having an entry end and an exit end with a second endless belt adapted to convey wool through said second bowl;

one or more second bowl solvent shower devices adapted to spray solvent under pressure to

further cleanse said wool as it traverses said second bowl;

first weir means adapted to receive solvent from said second bowl and cascade said second bowl solvent over wool on an elevated portion of said first endless belt out of contact with solvent in said first bowl;

second weir means adapted to receive pure solvent and cascade said pure solvent over wool disposed on an elevated portion of said second endless belt out of contact with solvent in said second bowl;

said first endless belt being adapted to convey said wool to the exit end of said bowl for entry to the entry end of said second bowl.

8. Apparatus as defined in claim 7 further comprising a solvent outlet adapted to dispense solvent to wet wool entering said first bowl.

9. Apparatus as defined claim 7 or 8 further comprising two solvent co-flow outlets adapted respectively to introduce solvent under pressure into said first and second bowls to force wool located on said first and second endless belts at respective entry ends of said first and second bowls to ride respective said first and second endless belts towards respective exit ends of said first and second bowls.

10. Apparatus as defined in any one of claims 7 - 9 further comprising a first bowl filter and a second bowl filter, respective said bowl filters being adapted to receive predetermined quantities of solvent from respective said first and second bowls to filter said solvent quantities and return cleansed solvent to respective first and second bowl shower devices.

11. Apparatus as defined in any one of claims 7 and 10 further comprising a solvent reservoir from which pure solvent may be directed for admission to said second bowl over said second bowl weir.

12. Apparatus as defined in any one of claims 7 - 11 further comprising a centrifuge into which wool is conducted through the exit end of said second bowl, the exit from said second bowl being adjacent the upper extremity of said elevated portion of said second bowl endless belt.

13. Apparatus as defined in claim 6 as appended to claim 5, or 12 as appended to 11 further comprising means for conducting solvent vapours from said bowl or bowls and said centrifuge to a condenser and means for conducting solvent from said condenser to said reservoir.

14. Apparatus as defined in claim 13 further comprising a final vapour trap adapted to receive residual vapour from said condenser, said final vapour trap being a carbon-activated adsorption unit vented to atmosphere.

15. Apparatus defined in any one of claims 6 or 11 to 14 further comprising a bank of filters adapted to receive used solvent contaminated with dirt and grease from said bowl or first bowl.

16. Apparatus as defined in claim 15 wherein waste material filtered by said bowl filters is conducted to said bank of filters.

17. Apparatus as defined in claim 15 or 16 wherein dirt from said bank of filters is conducted to a dirt drier and grease and solvent is conducted from said bank of filters to a series of stills.

18. Apparatus as defined in claim 17 wherein solvent is extracted from said dirt drier and from said stills and conducted to said solvent reservoir.

19. Apparatus as defined in claim 17 or claim 18 wherein dirt from said dirt drier is conducted to a foreign material collection chamber.

20. Apparatus as defined in any one of claims 17 and 19 wherein grease from said stills is conducted to a grease collection tank.

21. Apparatus as defined in any one of the preceding claims substantially sealed to atmosphere and adapted to operate under pressure slightly less than atmospheric pressure.

22. A method for processing animal fibre, particularly raw wool, comprising the steps of: admitting said fibre to a solvent bowl, transporting said fibre on an endless belt in said bowl, showering said fibre as it is carried by said endless belt with solvent from one or more solvent showers to cleanse said fibre, and cascading solvent into said bowl over a weir so that cascading solvent cleanses said wool on an elevated portion of said endless belt at a location out of contact with solvent in said bowl.

23. A method as defined in claim 22 further comprising the step of wetting said fibre entering said bowl by solvent dispensed through a solvent outlet.

24. A method as defined in claims 22 or 23 further comprising the step on introducing a co-flow of solvent into said bowl in a location to force fibre located on said endless belt in the vicinity of the bowl entry end to ride said endless belt towards the fibre exit end of said bowl.

25. A method as defined in any one of claims 22 to 24 further comprising the step of utilizing a bowl filter to filter a predetermined quantity of solvent from said solvent bowl and return said filtered solvent in substantially pure form to said one or more shower devices.

26. A method as defined in any one of claims 22 and 25 further comprising the step of directing pure said solvent from a solvent reservoir for admission to said bowl over said weir.

27. A method as defined in any one of claims 22 to 26 further comprising conducting treated wool from said bowl to centrifuge, said fibre exiting said bowl from a bowl exit portion located adjacent the upper reach of said elevated endless belt portion.

28. A method for processing raw (greasy) wool comprising the steps of admitting said raw wool into the entry end of a first solvent bowl, carrying said raw wool on a first endless belt in said first bowl, showering said raw wool with a solvent shower sprayed under pressure onto said wool as said wool is carried by said first bowl endless belt,

conveying said wool on an elevated portion of said first endless belt and cascading solvent over a weir onto said wool as it is located on said first endless belt elevated portion above the level of solvent in said first bowl,

directing wool from the end of said first bowl endless belt to a second bowl endless belt,

transporting said wool through said second bowl on said second bowl endless belt,

showering said wool on said second bowl endless belt with solvent sprayed under pressure from one or more shower devices located in said second bowl,

thereafter transporting said wool on an elevated portion of said second bowl endless belt,

cascading over said wool as it is carried on said second bowl endless belt elevated portion, pure solvent from a second weir to which said pure solvent is admitted, and

causing wool to exit said second bowl.

29. A method as defined in claim 28 comprising the further step of wetting wool admitted to said first bowl by solvent dispensed from a solvent outlet.

30. A method as defined in claims 28 or 29 further comprising the step of providing solvent co-flow in each of the first and second bowls to introduce solvent under pressure into said first and second bowls to force wool located on said first and second endless belts respectively, at respective entry ends of said first and second bowls, to ride respective said first and second endless belts towards respective exit ends of said first and second bowls.

31. A method as defined in any one of claims 28 to 30 further comprising the step of providing first and second bowl filters, conducting solvent from respective said first and second bowls to said respective first and second bowl filters in predetermined quantities, filtering said predetermined solvent quantities in said first and second bowl filters and returning cleansed solvent from respective first and second bowl filters to respective said first and second bowl shower devices.

32. A method as defined in any one of claims 28 to 31 comprising the further step of providing a solvent reservoir and directing pure solvent from said solvent reservoir for admission to said second bowl over said second bowl weir.

33. A method as defined in any one of claims 28 to 32 comprising the further step of conducting wool from the exit end of said second bowl to a centrifuge and drying the wool therein.

34. A method as defined in claim 27 as appended to claim 26, or 33 as appended to claim 32 further comprising the step of conducting solvent vapours from said bowl or bowls and said centrifuge to a condenser and further conducting solvent from said condenser to said reservoir.

35. A method as defined in claim 34 further comprising conducting residual vapour from said condenser to a final vapour trap, said final vapour trap being a carbon-activated adsorption unit vented to atmosphere.

36. A method as defined in any one of claims 26 or 27 or 32 to 34 further comprising conducting used solvent contaminated with dirt and grease from said bowl or first bowl to a bank of filters.

37. A method as defined in claim 36 comprising the further step of conducting waste material filtered by said bowl filter or filters to said bank of filters.

38. A method as defined in claim 36 or 37 comprising the further step of conducting dirt from said bank of filters to a dirt drier and conducting grease and solvent from said bank of filters to a series of stills.

39. A method as defined in claim 38 comprising the further step of extracting solvent from said dirt drier and from said stills and conducting said extracted solvent to said solvent reservoir.

40. A method as defined in claim 38 or 39 comprising the further step of conducting dirt from said dirt dryer to a foreign material collection chamber.

41. A method as defined in any one of claims 38 to 40 comprising the further step of conducting grease from said stills to a grease collection tank.

42. A method as defined in any one of claims 22 to 42 comprising the further step of conducting said method in apparatus substantially sealed to atmosphere and operated under a pressure slightly less than atmospheric pressure.

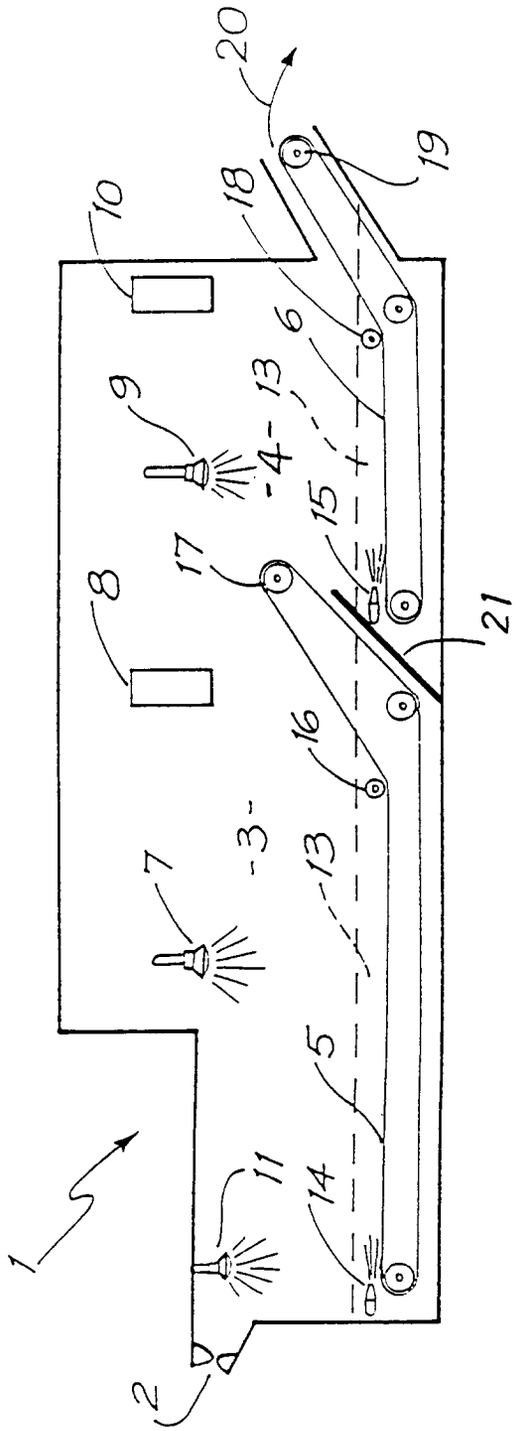

FIG. 1

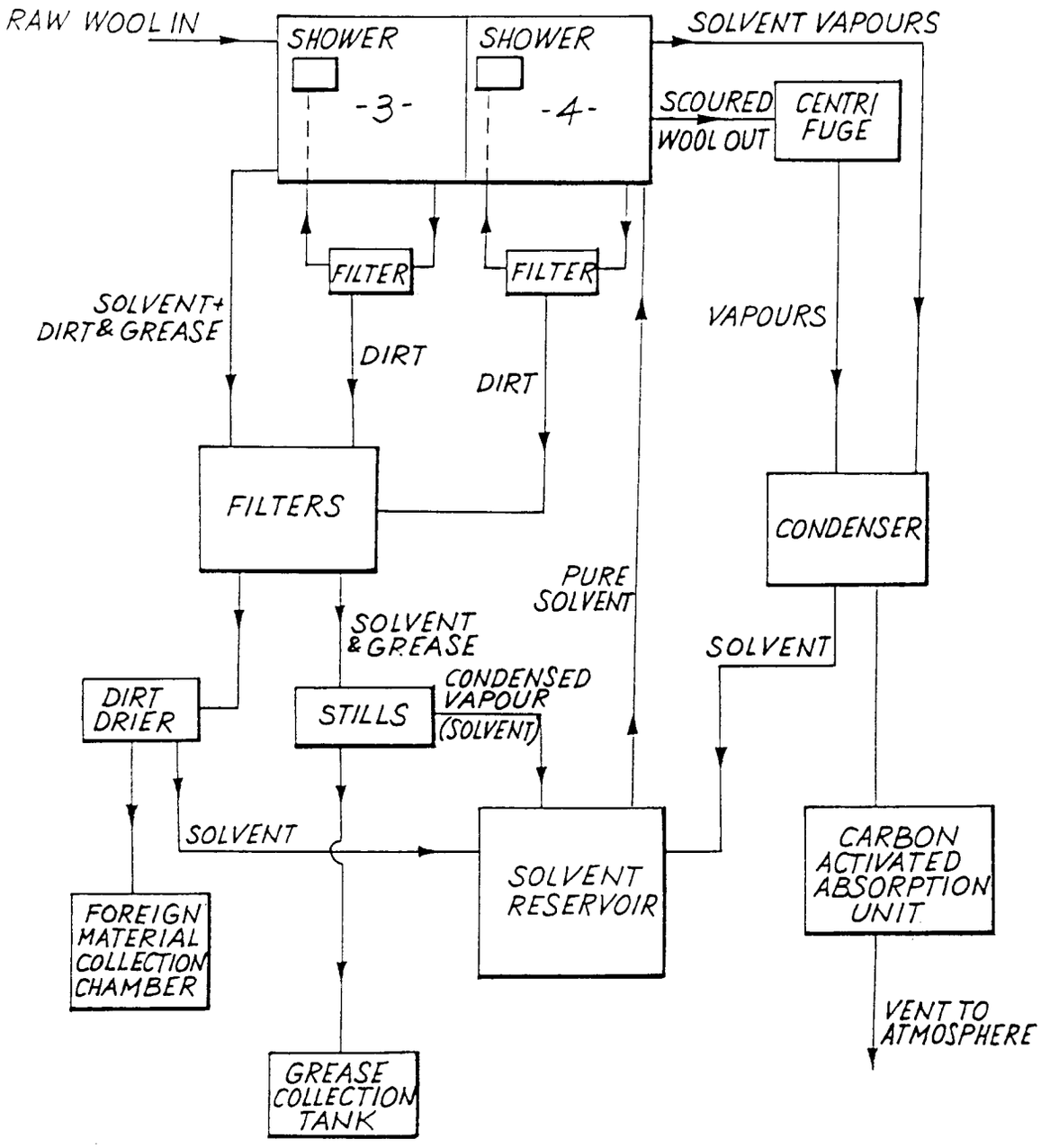
RAW WOOL IN
SHOWER -3-
SHOWER -4-
SOLVENT VAPOURS
SCOURED WOOL OUT
CENTRI FUGE
FILTER
FILTER
SOLVENT+ DIRT & GREASE
DIRT
DIRT
VAPOURS
FILTERS
CONDENSER
PURE SOLVENT
SOLVENT & GREASE
SOLVENT
DIRT DRIER
STILLS
CONDENSED VAPOUR (SOLVENT)
SOLVENT
SOLVENT RESERVOIR
CARBON ACTIVATED ABSORPTION UNIT
FOREIGN MATERIAL COLLECTION CHAMBER
VENT TO ATMOSPHERE
GREASE COLLECTION TANK

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 31 1366

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	US-A-3 393 537 (CHAIKIN,M.ET AL) * column 1, line 51 - column 4, line 39; claim 1; figure 2 *	1,2,3	D01B3/04 D01B3/10 D06B3/02
A		7,23,28	D06B9/00

Y	US-A-2 975 625 (LUNDGREN,S.O.) * column 1, line 35 - column 3, line 68; claim 1; figure 2 *	1,2,3	
A		6,7,11, 12	

Y	FR-A-1 233 584 (SEPARATOR AB) * page 2, paragraph 4 - page 2, paragraph 1; figure 3 *	1,2,3	
A		9,30	

A	US-A-3 693 382 (GRANTHAM,F.W.) * column 3, line 51 - column 9, line 24; figures 1,16 *	1,9	
	-----		TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D01B D06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 DECEMBER 1992	MUNZER E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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