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(19)



(54) A DYEING APPARATUS

(71) We, YOSHIDA KOGYO K.K., a Corporation duly organised under the Laws of Japan and existing at No. 1, Kanda Izumi-cho, Chiyoda-ku, Tokyo, Japan, and NIPPON DYEING MACHINE MFG. CO. LTD. a Corporation duly organised under the Laws of Japan and existing at No. 123, Aza-Unowari, Ooaza-Kaniehonmachi, Kanie-cho, Ama-gun, Aichi-ken, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in and relating to a dyeing apparatus, more particularly to such an apparatus which is equipped with a perforated cylinder or beam around which a material to be dyed is wound.

Conventional dyeing apparatus of the type described generally comprise a dyeing vessel connected to a dye circulating system including a motor, a pump, conduit piping and a heat-exchanger, the arrangement being that dye liquid is supplied to and withdrawn from the vessel and circulated back to the vessel, in which instance the vessel is required to be filled up so as to ensure complete soaking of the material within the vessel. With such conventional apparatus, increased amounts of dye liquid have been required to carry out the beam dyeing operation; usually about from 1:15 to 1:25 bath ratios of material to dye liquid being used. Consequently, it has been necessary to increase the size or capacity of the motors, pumps, heat-exchangers and other equipment associated with the dyeing vessel or required to treat waste liquid.

According to the invention, there is provided a dyeing apparatus comprising: a vessel having a substantially circular cross-section; a perforated cylinder or beam mounted concentrically within said vessel and adapted to wind thereon a material to be dyed; a confining non-perforated cylinder interposed concentrically between said vessel and said beam and provided at its upper portion with a longitudinally extending opening for permitting an overflow of dye liquid; and means circulating a dye liquid through said vessel.

The invention will now be described by way of example, with reference to the accompanying drawings, wherein:—

Figure 1 is a longitudinal cross-sectional, partly schematic, view of a beam dyeing apparatus provided in accordance with the invention;

Figure 2 is a transverse cross-sectional view taken on the line II—II of Figure 1;

Figure 3 is a sectional view of a portion of the apparatus shown in Figure 1; and

Figure 4 is a sectional view of another portion of the apparatus of Figure 1.

Referring now to the drawings and Figure 1 in particular, there is shown a beam-dyeing apparatus generally designated at 10, which apparatus comprises a horizontally mounted vessel 11 which is generally circular in its cross section. A perforated cylinder 12, commonly known as a beam, is mounted concentrically within the vessel 11. The beam 12 has a pair of rollers 13,13′ at its opposite ends which are movably mounted on a rail 14 secured to and extending longitudinally of the vessel 11.

An intermediate confining, non-perforated cylinder 15 is interposed concentrically between the inner wall of the vessel 11 and the outer wall of the beam 12. The intermediate confining cylinder 15 is provided at its upper portion adjacent to the rail 14 with a longitudinally extending opening 16 for purposes hereafter to be described.

As better shown in Figure 2, there are formed a first circumferential chamber 17, hereinafter referred to as a circulation chamber, between the inner wall of the vessel 11 and the outer wall of the confining cylinder 15, and a second circumferential chamber 18, hereinafter referred to as a treatment chamber, between the inner wall of the confining cylinder 15 and the outer wall of the beam 12.

Referring back to Figure 1, the front end of the beam 12, upon being inserted into the vessel 11, is closed by a lid 19 which has a bevelled portion 20 (Figure 3) engageable with a bracket member 21. A plurality of these

bracket members 21 are provided adjacent each end of the beam 12 to confine and hold the fabric *F* wound around the beam 12 which is to be dyed.

The lid 19 is centrally engageable with a rod 22 connected to a handle 23. Rotating this handle in one direction clamps the lid 19 to seal the front end of the beam 12 and in the opposite direction releases the lid 19 to permit removal of the beam 12 when a cycle of dyeing operation has been completed. The lid 19 is covered by a removable cap 24 which is threadedly engaged with the handle rod 22 and which has a rim 25 disposed for sealed engagement with a similar rim 26 formed on the vessel 11. The two rims 25,26 are clamped together by a clamping ring 27.

A dummy non-perforated cylinder 28 is mounted concentrically within the perforated cylinder or beam 12, and has a conically shaped, closed rear end 29 which is supported in place by arms 30 extending suitably from a rigid frame member not shown. The open front end of the dummy cylinder 28 is closed by the lid 19, as a recessed rim 31 formed on the cylinder 28 is fitted with a projection 32 on the lid 19, as shown in Figure 3. The dummy cylinder 28 is provided primarily for the purpose of minimizing idle space S_1 within the beam 12 and hence economizing the use of operating dye liquid. To achieve the same purpose, a partition member 33 is provided to isolate idle space S_2 at the rear end portion of the vessel 11 from the liquid circulating areas of the vessel, the member 33 extending from the wall of the vessel 11 and tieing into the peripheral edge of a flared connector 34, later described, as shown in Figures 1 and 4.

Another partition member 35 is provided to isolate idle space S_3 defined by the cap 24 from the liquid circulating areas of the vessel 11, the member 35 being secured circumferentially to the rim 25 of the cap 24.

A withdrawal conduit 36 is connected at one of its ends to the bottom of the vessel 11 adjacent to the front end thereof and at the other end to a heat exchanger 37 adapted to maintain the dye liquid at a predetermined temperature. A pump 38 driven by a motor 39 is connected at its suction side to the heat exchanger 37 via conduit 40 at its discharge side to a flared connector 34 via conduit 41, the flared connector 34 having its flared end substantially coextensive in diameter with the beam 12 to effect uniform distribution of dye liquid through the treatment chamber 18.

A vent hole 42 is formed in the upper portion of the partition member 33 adjacent to the rail 14, as better shown in Figure 4, the hole 42 being adapted to equalize the pressure in idle space S_2 with the pressure in the liquid circulating regions of the vessel 11, thereby permitting of the use of reduced width material for the partition 3.

For the same reason, there is provided a similar vent hole 43 in the lid 19 adjacent to the upper portion of the dummy cylinder 28 to equalize the pressure in idle space S_1 with the liquid resident pressure. A blind member 44 is provided to mask the hole 43 and thereby to prevent entry of the dye liquid into the dummy cylinder 28. There is also for the same reason provided a vent pipe 45 which is adapted to equalize the pressure in idle space S_3 with the liquid resident pressure.

In operation of the dyeing apparatus 10 of the invention, the dye liquid is supplied by the pump 38 through the discharge conduit 41 and through the flared connector 34 whereupon the liquid is distributed uniformly through the treatment chamber 18. The liquid is forced radially outwardly through the perforated beam 12 and into the layer of fabric *F* wound thereon, and ascends under pressure toward the longitudinal opening 16 in the confining cylinder 15, as schematically illustrated in Figure 2. The dye liquid, after soaking the fabric layer *F* to depth, is allowed to overflow through the opening 15 into the circulation chamber 17 and is collected at the bottom of the vessel 11, from which used dye liquid is withdrawn through a flow rectifier 46, conduit 36, heat exchanger 37 and conduit 40 back to the pump 38. The dye liquid is thus re-circulated through the dyeing system to repeat the operation.

WHAT WE CLAIM IS:—

1. A dyeing apparatus comprising: a vessel having a substantially circular cross-section; a perforated cylinder or beam mounted concentrically within said vessel and adapted to wind thereon a material to be dyed; a confining non-perforated cylinder interposed concentrically between said vessel and said beam and provided at its upper portion with a longitudinally extending opening for permitting an overflow of dye liquid; and means circulating a dye liquid through said vessel.

2. A dyeing apparatus as claimed in claim 1 which includes a dummy cylinder mounted concentrically within said beam and isolated internally from the liquid circulating regions.

3. A dyeing apparatus as claimed in claim 1 wherein said vessel is provided with means for isolating idle space therein from the liquid circulating regions.

4. A dyeing apparatus as claimed in claim 3 wherein said means is provided with a vent hole.

5. A dyeing apparatus as claimed in claim 2 wherein said dummy cylinder is provided with a vent.

6. A dyeing apparatus as claimed in claim 1 wherein said circulating means includes a flared connector opening into said beam.

7. A dyeing apparatus as claimed in claim 1 wherein the inner wall of said vessel and the outer wall of said confining cylinder define therebetween a circumferential chamber for

bracket members 21 are provided adjacent each end of the beam 12 to confine and hold the fabric *F* wound around the beam 12 which is to be dyed.

The lid 19 is centrally engageable with a rod 22 connected to a handle 23. Rotating this handle in one direction clamps the lid 19 to seal the front end of the beam 12 and in the opposite direction releases the lid 19 to permit removal of the beam 12 when a cycle of dyeing operation has been completed. The lid 19 is covered by a removable cap 24 which is threadedly engaged with the handle rod 22 and which has a rim 25 disposed for sealed engagement with a similar rim 26 formed on the vessel 11. The two rims 25,26 are clamped together by a clamping ring 27.

A dummy non-perforated cylinder 28 is mounted concentrically within the perforated cylinder or beam 12, and has a conically shaped, closed rear end 29 which is supported in place by arms 30 extending suitably from a rigid frame member not shown. The open front end of the dummy cylinder 28 is closed by the lid 19, as a recessed rim 31 formed on the cylinder 28 is fitted with a projection 32 on the lid 19, as shown in Figure 3. The dummy cylinder 28 is provided primarily for the purpose of minimizing idle space S_1 within the beam 12 and hence economizing the use of operating dye liquid. To achieve the same purpose, a partition member 33 is provided to isolate idle space S_2 at the rear end portion of the vessel 11 from the liquid circulating areas of the vessel, the member 33 extending from the wall of the vessel 11 and tieing into the peripheral edge of a flared connector 34, later described, as shown in Figures 1 and 4.

Another partition member 35 is provided to isolate idle space S_3 defined by the cap 24 from the liquid circulating areas of the vessel 11, the member 35 being secured circumferentially to the rim 25 of the cap 24.

A withdrawal conduit 36 is connected at one of its ends to the bottom of the vessel 11 adjacent to the front end thereof and at the other end to a heat exchanger 37 adapted to maintain the dye liquid at a predetermined temperature. A pump 38 driven by a motor 39 is connected at its suction side to the heat exchanger 37 via conduit 40 at its discharge side to a flared connector 34 via conduit 41, the flared connector 34 having its flared end substantially coextensive in diameter with the beam 12 to effect uniform distribution of dye liquid through the treatment chamber 18.

A vent hole 42 is formed in the upper portion of the partition member 33 adjacent to the rail 14, as better shown in Figure 4, the hole 42 being adapted to equalize the pressure in idle space S_2 with the pressure in the liquid circulating regions of the vessel 11, thereby permitting of the use of reduced width material for the partition 3.

For the same reason, there is provided a similar vent hole 43 in the lid 19 adjacent to the upper portion of the dummy cylinder 28 to equalize the pressure in idle space S_1 with the liquid resident pressure. A blind member 44 is provided to mask the hole 43 and thereby to prevent entry of the dye liquid into the dummy cylinder 28. There is also for the same reason provided a vent pipe 45 which is adapted to equalize the pressure in idle space S_3 with the liquid resident pressure.

In operation of the dyeing apparatus 10 of the invention, the dye liquid is supplied by the pump 38 through the discharge conduit 41 and through the flared connector 34 whereupon the liquid is distributed uniformly through the treatment chamber 18. The liquid is forced radially outwardly through the perforated beam 12 and into the layer of fabric *F* wound thereon, and ascends under pressure toward the longitudinal opening 16 in the confining cylinder 15, as schematically illustrated in Figure 2. The dye liquid, after soaking the fabric layer *F* to depth, is allowed to overflow through the opening 15 into the circulation chamber 17 and is collected at the bottom of the vessel 11, from which used dye liquid is withdrawn through a flow rectifier 46, conduit 36, heat exchanger 37 and conduit 40 back to the pump 38. The dye liquid is thus re-circulated through the dyeing system to repeat the operation.

WHAT WE CLAIM IS:—

1. A dyeing apparatus comprising: a vessel having a substantially circular cross-section; a perforated cylinder or beam mounted concentrically within said vessel and adapted to wind thereon a material to be dyed; a confining non-perforated cylinder interposed concentrically between said vessel and said beam and provided at its upper portion with a longitudinally extending opening for permitting an overflow of dye liquid; and means circulating a dye liquid through said vessel.

2. A dyeing apparatus as claimed in claim 1 which includes a dummy cylinder mounted concentrically within said beam and isolated internally from the liquid circulating regions.

3. A dyeing apparatus as claimed in claim 1 wherein said vessel is provided with means for isolating idle space therein from the liquid circulating regions.

4. A dyeing apparatus as claimed in claim 3 wherein said means is provided with a vent hole.

5. A dyeing apparatus as claimed in claim 2 wherein said dummy cylinder is provided with a vent.

6. A dyeing apparatus as claimed in claim 1 wherein said circulating means includes a flared connector opening into said beam.

7. A dyeing apparatus as claimed in claim 1 wherein the inner wall of said vessel and the outer wall of said confining cylinder define therebetween a circumferential chamber for

the passage of dye liquid overflowing from said longitudinal opening.

8. A dyeing apparatus as claimed in claim 1 wherein the inner wall of said confining cylinder and the outer wall of said beam define therebetween a circumferential chamber for the passage of dye liquid radially outwardly through the wound material.

9. A dyeing apparatus substantially as herein described with reference to and as illustrated in the accompanying drawings.

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