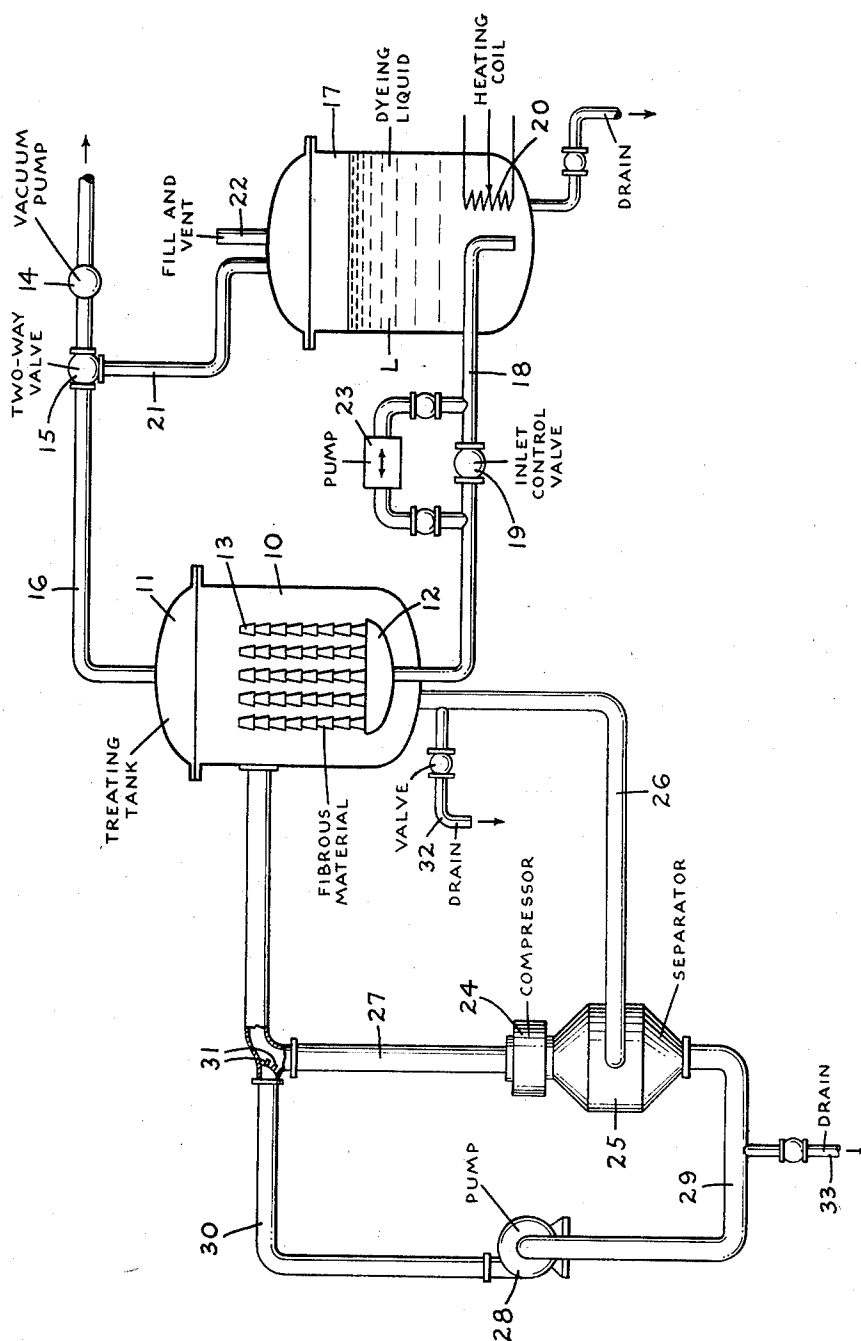


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METHOD OF TREATING WITH LIQUID A MATERIAL
IN GRANULAR, THREADED OR FIBROUS FORM
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METHOD OF TREATING WITH LIQUID A MATERIAL IN GRANULAR, THREADED, OR FIBROUS FORM

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2 Claims. (Cl. 8—158)

The method of my copending patent application Serial No. 303,474, filed August 9, 1952, now abandoned, has for its object to provide inter alia a dyeing process by means of which it is possible starting from a labile initial state with a maximum concentration of dye in the dyeing bath and with no dye on or in the material to be dyed to achieve in the shortest possible time a final state with a minimum concentration of dye in the dyeing bath and in which the distribution of the dye on or in the material is completely uniform. This method of treating with liquid a material in granular, threaded and fibrous form comprises the steps of placing the material to be treated in a closed circulation system, creating a partial vacuum in the circulation system for sucking into the system a quantity of treatment liquid sufficient to cover the material placed in the system and evacuating the material therein, subsequently abruptly lifting the vacuum for causing the treatment liquid to be sucked into and between the material placed in the circulation system, then removing from the circulation system substantially all treatment liquid in excess of the quantity retained by the material and required for the treatment thereof, and subsequently circulating a flow of a gaseous fluid through the said system and the material therein for nebulizing the treatment liquid retained by the material thereby removing in droplet form the liquid retained by the material.

When dyeing certain threaded or fibrous materials and when using certain dyes, it has been found in practice that the final state referred to cannot be attained as rapidly as desirable, and to remove this disadvantage, in accordance with the present invention, the dyeing liquid, after it has filled the system sufficiently to cover the material and before the major portion of the dyeing liquid is removed, is imparted a vigorous, preferably pulsating movement so that it is repeatedly forced through the material. Preferably this is made immediately after the material has been covered by the dyeing liquid, because in this stage the swelling of the material has not reached such an extent that the penetration of the dye particles into the material is made difficult. Such a pulsating movement may be brought about by alternately raising and lowering (preferably without exposing the material) the liquid level in the receptacle which contains the material and communicates with an expansion vessel, by subjecting said liquid level and thereby the entire dyeing liquid to a pressure which is alternately lowered and raised. In this manner, the dyeing liquid, which is preferably introduced in a boiling state into the receptacle, will be repeatedly forced through the material, and this alternately in the opposite directions, the dyeing liquid being brought to the boiling state anew when the pressure acting on the liquid level is lowered. In this manner, after a short period of time so much dye will be present on and in the material that when in accordance with the method of my copending patent application Serial No. 305,474, filed August 30, 1952, now Patent

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No. 2,773,404 the last step (the nebulizing of the dyeing liquid and its removal by the circulating gas or air flow) is carried out, the above described final state is reached after the shortest possible time.

For a better understanding of the present invention reference may be had to the accompanying drawing in which the single figure is a schematic illustration of a typical apparatus according to the present invention.

As shown in the drawing, the invention may be practiced in a closed system including a treating chamber 10 having a removable cover 11 which is secured to the chamber 10 in gas-tight relation. A manifold 12 is mounted within the chamber and is provided with perforated pipes, not shown, on which spools 13 of fibrous material may be stacked for treatment in the system.

A vacuum is drawn in the chamber 10 by means of a vacuum pump 14 which is connected by means of a two-way valve 15 and a conduit 16 to the chamber and communicates with its interior. With the valve in one position, the vacuum pump acts to produce a reduced pressure in the chamber thereby enabling a treating liquid, such as the dyeing liquid L to be drawn from a storage tank 17 through the pipe 18 and an "on-off" type control valve 19, into the manifold 12 and thence through the spools of fibers to fill the chamber 10 above the level of the topmost spools therein.

The treating liquid L in the storage tank 17 may be heated by means of a heating coil 20 or its equivalent.

The two-way valve 15 further communicates by means of a pipe or conduit 21 with the storage chamber 17 so that when the valve 15 is moved to a second position, the vacuum pump is disconnected from the chamber 10 and the upper part of chamber 12 is connected to the upper part of the storage chamber 17 thereby allowing liquid to drain back into the storage chamber. Such drainage is aided by providing the storage chamber 17 with a vent 22 which establishes atmospheric pressure in the treating chamber and the storage chamber.

Impregnation of the fibrous material is enhanced by providing the system with a pump 23 which serves to supply liquid from the chamber 17 to the treating chamber 10 and to withdraw liquid from the treating chamber 10 thereby raising and lowering the level of the liquid in the chamber 10 while the spools of fibrous material are immersed therein and thereby varying the pressure of the liquid in the chamber. The pump may also be used to withdraw liquid from the chamber 10 and return it to storage.

At the conclusion of the liquid treatment, air may be circulated through the treating chamber 10 while it is in a closed condition by means of an air compressor 24 which has its intake end connected to a cyclone separator 25 which is connected by means of a conduit or a pipe 26 to the bottom of the treating chamber. The exhaust or discharge port of the compressor 24 is connected by means of a pipe 27 to the upper portion of the treating chamber 10 to form a closed circuit therewith. Accordingly, when the compressor is set into operation, air is circulated through the chamber 10 and is heated by the compressor to facilitate the further treatment and drying of the fibrous material in the chamber. The droplets of liquid which are blown off of the spools of fiber in the form of spray are carried into the separator and are separated from the air. All or part of the removed liquid can be restored to the operating cycle by means of a pump 28 which has its inlet connected by means of a pipe 29 to the liquid discharge outlet of the separator 25. The pressure side of the pump 28 is connected by means of a conduit 30 to the conduit or pipe 27 and may be provided with a series of spray nozzles 31 for spraying the liquid in a finely-

divided form into the gas being circulated through the chamber 10.

When desired, all of the liquid can be eliminated from the gas circulating system by means of an appropriate drain 32 located in the bottom of the chamber 10 and a drain 33 communicating with the liquid outlet of the separator 25.

The above-described apparatus enables the fibrous material to be subjected to reduced pressure and a higher pressure while immersed in the treating liquid, and it also enables all or a part of the treating liquid to be removed from the treating chamber 10 and the fibrous material subjected to further treatment with a circulating, heated gas containing a finely-divided treating liquid whereby a uniform product is obtained. The final treatment obtainable with the apparatus is the drying of the fibrous material by circulation of the heated, relatively dry air or gas through the chamber by means of the compressor 24.

It is obvious that the method of this invention can be used not only for dyeing but for any liquid treatment.

Having now particularly described the nature of my invention and the manner of its operation what I claim is:

1. A method of treating with liquid, granular materials, threaded materials, fibrous materials, textile and yarn materials comprising the steps of placing the material to be treated in a closed circulation system, creating a partial vacuum in the circulation system, connecting the system to a supply of treatment liquid for sucking into the system a quantity of treatment liquid sufficient to cover the material placed in the system while maintaining a partial vacuum in said system, subsequently abruptly lifting the vacuum for causing the treatment

liquid to at least partially impregnate the material placed in the circulation system, alternately increasing and decreasing the pressure on the treatment liquid by raising the level of the liquid and lowering the level of the liquid with respect to the material while the material is covered thereby to force the treatment liquid repeatedly into the material, then removing from the circulation system substantially all treatment liquid in excess of the quantity retained by the material, and subsequently circulating a gaseous fluid through the said system and the material therein for removing substantially all of the excess liquid retained by the material.

2. The method of claim 1 wherein the treatment liquid is admitted into the circulation system at boiling temperature and after cooling below boiling temperature in the system, is again boiled by lowering the pressure in said system.

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