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Lau et al.

[11] **3,908,587**

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[54] **APPARATUS FOR IMPREGNATING CORRUGATED CARDBOARD**

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[52] **U.S. Cl.** **118/50;** 118/603; 118/317

[51] **Int. Cl.**[2] **B05C 7/02**

[58] **Field of Search** ..... 118/50, 7, 317, 5, 603; 417/68; 117/102 L, 102 A

[56] **References Cited**

UNITED STATES PATENTS

1,781,375	11/1930	Easton	417/68
3,592,159	7/1971	Murphy	118/7
3,669,064	6/1972	Hoelzinger et al.	118/50 X
3,669,067	6/1972	Achermann et al.	118/317 X

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[57] **ABSTRACT**

A method of and apparatus for impregnating corrugated cardboard or the like in the environment in which a liquid impregnating agent is introduced along a longitudinal edge of horizontally disposed and advancing corrugated cardboard with the impregnant being drawn laterally through transversely extending flutes by means of vacuum pressure. Instead of using a single liquid ring vacuum pump employing water to establish its liquid ring, a plurality of liquid ring pumps are employed which use the liquid-impregnating agent itself to form the required liquid ring. With this arrangement, it no longer becomes necessary to remove the liquid impregnant agent, such as hot wax, in advance of its entry into the suction side of each liquid ring pump thereby improving the vacuum impregnation and permitting the use of a common separator element on the pressure discharge side of a plurality of liquid ring pumps.

5 Claims, 4 Drawing Figures

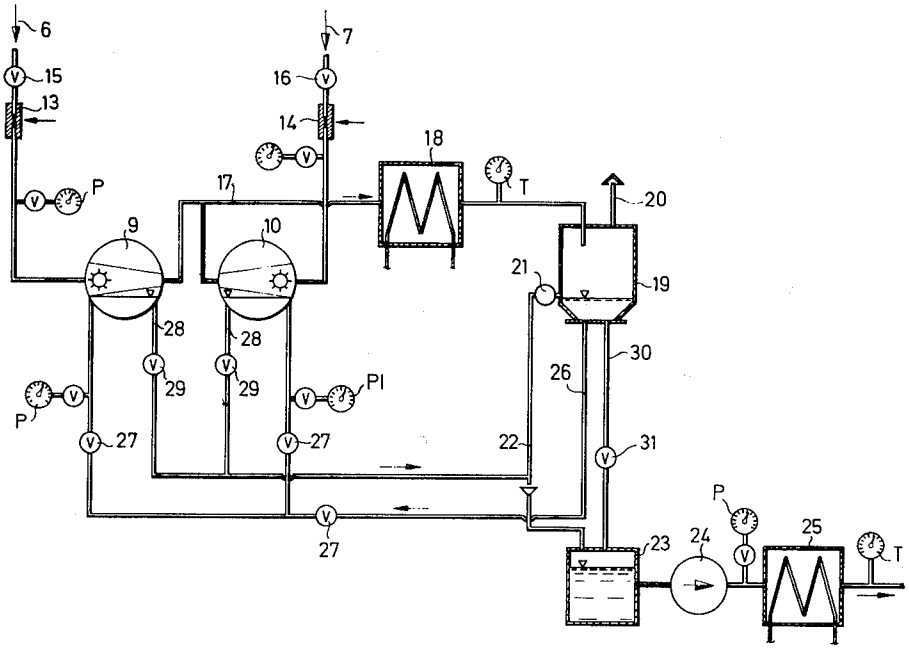


Fig.1

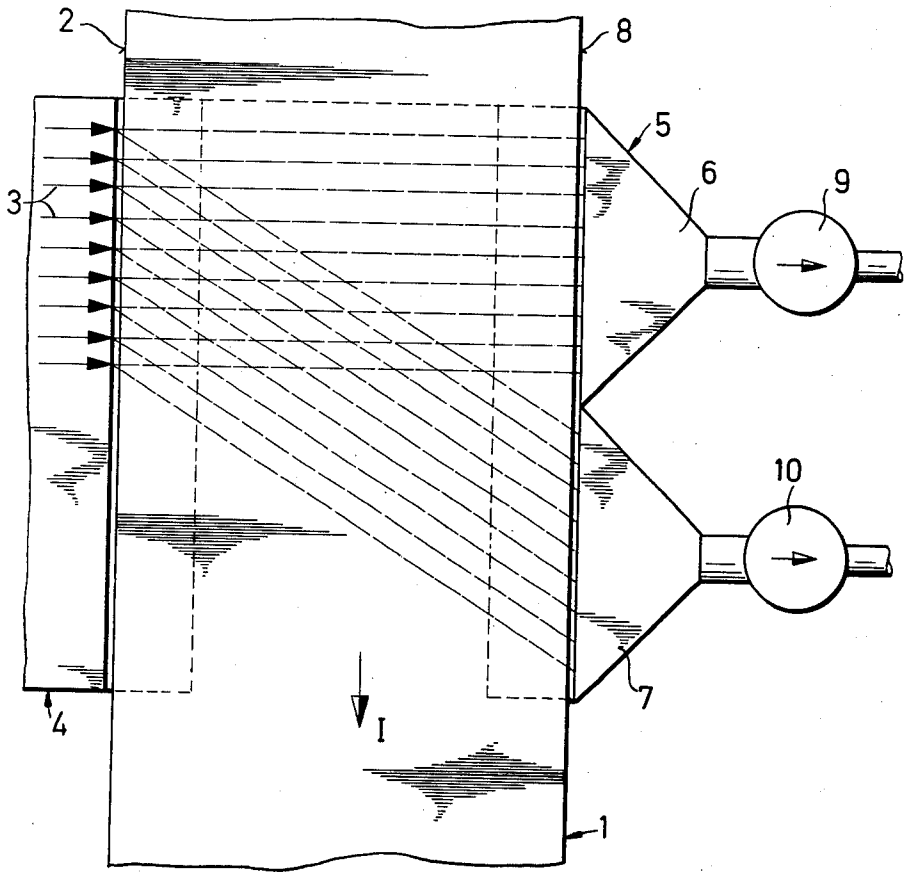


Fig.2

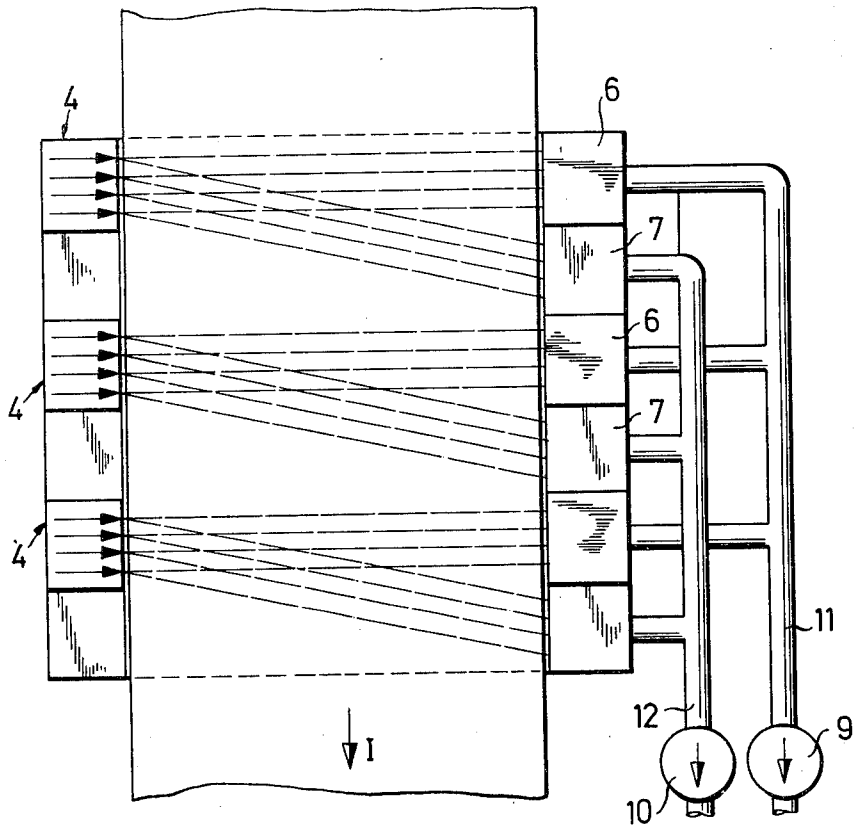
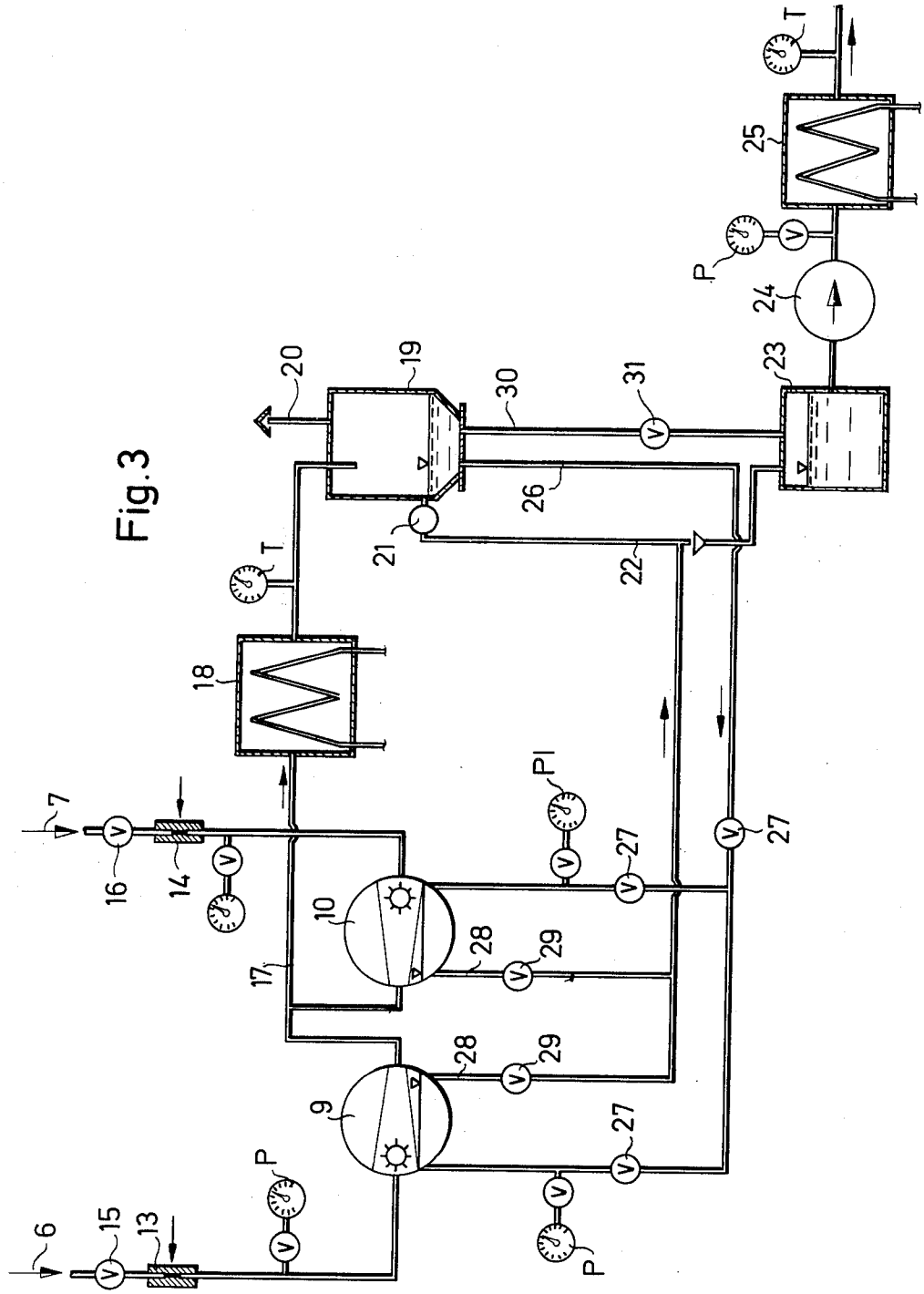


Fig.3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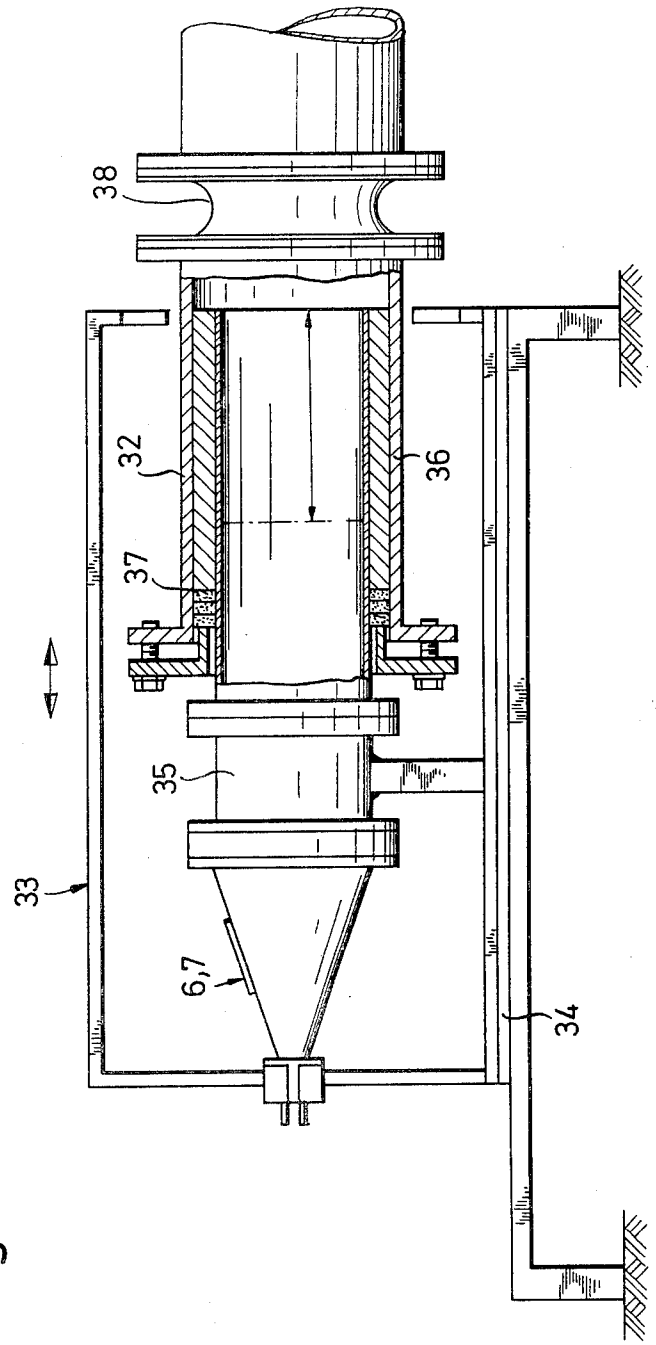

Fig.4

APPARATUS FOR IMPREGNATING CORRUGATED CARDBOARD

This invention relates to apparatus for impregnating corrugated board with a material having having waterproofing, structural reenforcement, or other desired characteristic and, more particularly, to such apparatus for so impregnating corrugated board while it is fed horizontally on a substantially continuous basis.

This invention constitutes an improvement over U.S. Pat. No. 3,669,064 (Hoelzinger et al.) and U.S. Pat. No. 3,699,067 (Achermann et al.), each of which were issued on June 13, 1972, to the common assignee of the present invention. In each of these inventions as well as in the present invention, a web of corrugated cardboard or paperboard is advanced in a substantially horizontal plane and a liquid impregnating agent is introduced by means of an application device along a longitudinal edge, laterally into the interior, and is transported by means of a vacuum with an air carrier means to the opposite longitudinal edge. Thereafter, the impregnating agent is separated from the mixture of air and impregnating agent with a portion of the mixture having been removed from the board by means of the suction of a liquid ring pump.

In a conventional process of this kind, the impregnant is directly injected into the interior of the corrugated cardboard via nozzles of the feeding or application device. The device is provided at the inlet of the corrugated board with a vacuum channel. The liquid impregnating agent is either injected into the interior of the corrugated board as a full stream and is suctioned off by a vaccum pump operating on the other longitudinal edge of the board or, alternatively, the impregnant is mixed with air according to the pistol principle, injected into the corrugated cardboard interior, and is likewise suctioned or drawn by vacuum pressure to the other longitudinal edge of the corrugated cardbaord by means of a vacuum pump. On the suction side of the corrugated cardboard, there are arranged several suction or vacuum chambers which are separated from each other and sealed along the longitudinal edge of the board. The suction chambers are connected to one or several vacuum pumps. Connected ahead of the pumps is a separator for the impregnant. So-called liquid ring pumps have been utilized as these pumps with the liquid ring formed by water. Connected at the outlet side of the pump, a separator is employed whose function is to separate the entrained water exiting at the pressure side of the liquid ring, together with air. The separated water is treated as lost water. The water lost from the liquid ring of the pump has to be replaced by fresh water.

Among the disadvantages of this conventional impregnating process is that each suction channel is not acted upon by a separate pump so that the suction channels are influenced by each other. Moreover, separators have to be connected ahead of the pumps. The number of required separators unnecessarily raises the cost of the plant and, in addition, the separators are not capable of completely separating the liquid impregnating agent, such as wax, and keep it fully from entering the impregnation channel. This in turn results in a high probability of failure of the liquid ring pump when actuated by a water ring.

In accordance with the present invention, an apparatus has been devised for impregnating a horizontally advancing cardboard web which succeeds in providing excellent vacuum pressure or a suction effect onto the cardboard web while achieving complete separation of the impregnating agent from the suctioned-off impregnating agent stream in a smooth, trouble-free operation. The invention accomplishes this objective in that the liquid ring for the liquid ring pump utilizes the liquid impregnating agent itself, and by utilizing several liquid ring pumps, separated from each other on the suction side, and connected to a common separator on the pressure side.

The fact that the fluid impregnating agent, such as wax, in used for the liquid ring of the liquid ring pump ensures that the impregnating agent cannot cause disorders, with regard to the liquid ring pump. The excess impregnant, which is not used for the liquid ring pump, is removed from the pump. By using a separator positioned downstream from the pumps such as by positioning a separator on the output pressure side of the pumps, the impregnant, such as wax, is separated from the air drawn in from the corrugated board. Thus only one single common separator is necessary, and the separators connected ahead of the pumps in the conventional impregnating system can be dispensed with. The separated impregnant may, if required, be re-cycled for maintaining the liquid ring necessary within the pumps. This results in a no-loss cycle. Finally, the invention provides for keeping the corrugated cardboard webs acted upon by the individual pumps via suction chambers, independently of each other.

In a further embodiment of the invention, the suctioned-off air-impregnating agent mixture is affected by pressure, and is preferably cooled. Especially when dealing with hot impregnating agents, for example wax, it is necessary to engage a cooling phase in order to avoid overheating of the ring fluid in the circuit for the pump. It is possible to heat the impregnating agent, if required for satisfactory operation, instead of cooling it.

In still another embodiment of the invention, the impregnant which has been removed by vacuum pressure is returned to a preparation container and is heated for its next intended use. In this manner the separated excess impregnating agent can be reused at the required temperature.

The apparatus for implementing the process is characterized in that there are provided for establishing the vacuum or suction condition for the air-impregnating agent mixture, several liquid ring pumps, which have their respective vacuum inputs arranged in parallel flow relationship and which are each connected to one of the suction chambers associated with one longitudinal edge, and is that on the pressure side the pumps feed a common separator, and in that each pump is in fluid communication with the common separator in order to maintain its liquid ring.

In a further embodiment of the invention, the separator is maintained by an overflow device and is kept at a constant overflow level. This is necessary in order to keep the pressure of the impregnating agent which is being returned to the pumps at a substantially constant level.

Preferably, a temperature control means in the form of either a cooling or heating device is connected ahead of the separator. This makes it possible to avoid unnecessary increase in the pump temperature caused by the existence of the impregnating agent in the cycle. Pref-

erably, a storage tank is connected at the outlet of the separator which also serves as a discharge container for the entire system, and is regulated on the basis of its level.

A further embodiment of the present invention provides for an adapter arrangement in which the suction chambers connected ahead of the pumps are movably arranged facing the longitudinal edge of the corrugated board, in which the pumps themselves are stationary, and in which the feeder line of each suction chamber to the respective pump has inserted in it a hollow slidable valve member. This makes it possible to establish a connection between the movable suction chambers and the stationary pump in a space-saving and reliable manner.

Other objects and advantages of the invention will become apparent upon a study of the following specification when viewed in the light of the accompanying drawings, in which:

FIG. 1 shows a schematic top plan view of one embodiment of the present invention;

FIG. 2 shows a top plan view of another embodiment of the present invention;

FIG. 3 is a flow arrangement of elements on the suction side of the corrugated board of FIG. 1; and,

FIG. 4 is an elevational view taken in vertical cross section and illustrating an adapter member used to interconnect adjustably positioned suction chamber members with stationary liquid ring pumps.

As can be seen from a reference to FIG. 1, the corrugated carboard web 1 is advanced horizontally in a corrugated cardboard device and is transported in the direction of arrow I. Associated with longitudinal edge 2, and adjustable in relationship thereto, there are provided nozzles, 3, which together with other components not depicted, such as guiding units as disclosed in Hoelzinger et al. U.S. Pat. No. 3,699,064 form impregnating device 4. The impregnating agent, for example hot wax, is injected by means of nozzles 3 into the interior of the corrugated board. As is conventional, the corrugated board has at least one planar fibrous outer layer cooperating with a serpentine layer to define a succession of transversely extending open-ended flutes. Opposite from the impregnating device 4 there is a suction device 5. This suction device 5 comprises, for instance, two suction chambers 6 and 7 which can be directed to the other longitudinal edge 8 of corrugated cardboard web 1 and which are sealed against this longitudinal edge. The suction chamber opposite nozzles 3 limits the direct suction path, while suction chamber 7, connected at its outlet, and running in direction I of the cardboard web, limits the after-suction or indirect path. As indicated schematically, the injected impregnating agent, as a result of the cardboard movement from the suction path of the after-suction path will be moving in oblique lines. It is significant that the impregnating agent, injected at longitudinal edge 2, does not completely fill the hollow channels or flutes of the corrugated web 1, so that the application side, along with the impregnating agent, air is suctioned in as a carrier means or means of transportation.

Connected behind suction chambers 6 and 7 and separated from each other, pumps 9 and 10 are located on the suction side. Liquid ring pumps are used for these pumps.

FIG. 2 shows a variation of this embodiment, wherein on the application side several coating devices 4 are arranged, spaced apart from each other. Opposite therefrom there are, respectively, suction chambers 6 and 7, determining the suction path and the after-suction path. All of the suction chambers 6 determining the direct suction path are connected to a common line, and all suction chambers 7 determining the after-suction path are combined at line 12, to which, in turn, pumps 9 and 10 are connected.

According to the flow diagram in FIG. 3, feeding lines from suction chambers 6 and 7 are connected via sliding valves 13, 14 and/or ventilation slide members 15, 16 to the suction side of liquid ring pumps 9, 10. The liquid ring pumps are of conventional construction. On the pressure side these pumps 9, 10 are connected to each other. A common exit line 17 is guided to a cooling device 18 in which the air-impregnating agent mixture is being cooled. The exit of the cooling device 18 is connected to separator 19. Separated air can escape via air exhaust 20, and the separated impregnating agent, for example wax, is guided to a collection container 23 with constant level regulation via overflow 21, in Line 22. Pump 24 switched on and off by the level regulating action of the collection container 23 transports the impregnating agent, via a heating device 25, back to a storage tank, not shown, which serves as a feeder for coating device 4. Liquid ring pumps 9, 10 are, in accordance with the invention, actuated by way of a liquid ring formed by the impregnating agent. In the present case, the impregnating agent, such as wax, is used to form the liquid ring directly in pumps 9, 10. In order to maintain the liquid ring in pumps 9, 10, wax is returned from separator 19 via line 26 and sliding valve 27 to pump 10 or 9, respectively.

In order to be able to clear the entire system, there are evacuating lines 28 guided via sliding valve 29 to storage container 23. In addition, a clearance line 30 leads from separator 19 via sliding valve 31 to the collection container 23.

Throughout FIG. 3, P and T designate the pressure or temperature measuring points, respectively, necessary for automatic control.

In order to maintain and space-saving connection between stationary pumps 9, 10 and the movable suction chambers 6, 7 there is inserted into each feeder line leading to pumps 9, 10, a slidable adapter 32 as illustrated in FIG. 4. The suction device as a whole is designated 33. It comprises suction chambers 6, 7. Suction device 33, by means of sliding guides 34, is adjustable and lockable in relationship to the corrugated cardboard web, not shown. Firmly connected to suction chambers 6, 7 is tube 35 which is slidable within stationary casing 36, which is connected to pump 9, 10, not shown. Packing box 37 seals tube 35 and casing from each other. A flexible connecting piece 38 is inserted into the feeder line leading to pumps 9, 10.

It would also be possible to arrange the pump unit together with the suction chambers in a movable association with the suction chambers. In this case the adapter portion of FIG. 4 is not necessary. Reference is made to the commonly owned issued patent of Hoelzinger et al. U.S. Pat. No. 3,669,064 and Achermann et al. U.S. Pat. No. 3,669,067 for details of construction and conventional operation not specifically disclosed herein.

While the process and apparatus for impregnating corrugated cardboard has been shown and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed,

and that changes in detail and construction may be made therein within the scope of the invention, without departing from the spirit thereof.

What is claimed is:

1. Apparatus for impregnating horizontally arranged and advancing corrugated board with a liquid impregnating agent having an air carrier means to form an air-impregnating agent mixture with said mixture being inserted into said board by means of an application device positioned along one longitudinal edge of the board, said apparatus comprising:

a. suction chamber means arranged along the longitudinal edge of said board opposite from said application device,

b. a plurality of liquid ring pumps each having a vacuum input,

1. the respective vacuum inputs of each liquid ring pump being in parallel flow relationship with the other vacuum inputs and each being coupled to said suction chamber means for drawing said mixture of air and liquid impregnating agent into said liquid ring pumps, said liquid ring pumps each forming a liquid ring therein with said liquid impregnating agent from said mixture,

2. common separator means having means communicating with the respective pressure output sides of said liquid ring pumps, and

3. means coupling said separator means to each of said pumps for providing said liquid impregnating agent thereto for supplementing the impregnating agent from said mixture and for maintaining said liquid ring with said liquid impregnating agent therefrom.

2. Apparatus as defined in claim 1 including means for maintaing the level of said liquid impregnating agent within predetermined limits within said common separator means.

3. Apparatus as defined in claim 1 including temperature control means positioned between the pressure exits of said liquid ring pumps and said common separator means.

4. Apparatus as defined in claim 1 including collection container means located downstream from said common separator means with said collection container means being in fluid communication with said common separator means and said liquid ring pumps, and system and level control means coupled to said common separator means, said collection container means and said liquid ring pumps for maintaining said impregnating agent levels therein and for permitting evacuation of said liquid impregnating agent.

5. Apparatus as defined in claim 1 wherein said suction chamber means includes members adjustably positionable along a longitudinal edge of said advancing corrugated board on a side opposite from said application device with said suction chamber members being interconnected by means of a hollow slidable valve member to one of said liquid ring pumps with the latter being mounted stationary.

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