(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 129 130**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **24.02.88**

(51) Int. Cl.[4]: **A 61 J 3/07**, A 61 J 5/00

(21) Application number: **84106344.9**

(22) Date of filing: **04.06.84**

(54) **Apparatus for sealing capsules.**

(30) Priority: **13.06.83 US 503950**

(43) Date of publication of application:
27.12.84 Bulletin 84/52

(45) Publication of the grant of the patent:
24.02.88 Bulletin 88/08

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(56) References cited:
EP-A-0 116 743
EP-A-0 116 744
EP-A-0 127 105
US-A-1 861 047
US-A-3 394 983

(73) Proprietor: **Capsulbond Incorporated**
Pearl Street
Hobart New York 13788 (US)

(72) Inventor: **Graham, Dean M.**
Pearl Street
Hobart New York 13788 (US)

(74) Representative: **Denmark, James**
c/o Bailey Walsh & Co. 5 York Place
Leeds LS1 2SD Yorkshire (GB)

Courier Press, Leamington Spa, England.

EP 0 129 130 B1

Description

The present invention relates to the preparation of capsules, such as may contain edible ingredients and comprise telescopically engaged capsule halves, and more particularly to an apparatus for permanently sealing such capsule halves to each other to render the capsules tamper-proof and tamper-evident.

The capsules with which the present invention is concerned are well known and have been in broad use for many years. Such capsules are generally prepared from an edible natural substance such as gelatin, and are generally cylindrical telescopically engaging tubes, each tube having one end thereof sealed, so that upon coaxial disposition, they are capable of holding a quantity of material. Generally, such capsules are utilized in the pharmaceutical and the food industries, to hold edible and pharmaceutically active materials such as medicines, vitamin preparations, and other edibles both solid and liquid. The materials from which the capsules are prepared are usually hydrophilic, and thereby adapted to dissolve in the intestine after ingestion.

One of the difficulties that has long been encountered in the use of such capsules as stated, has been their ability and occasional tendency to disengage from each other, whereby the contents of the capsule escape and are lost. Accordingly, the prior art is replete with numerous approaches directed to the maintenance of the sealing engagement between the capsule halves.

The problem of the disengagement of the capsule halves from each other has recently become more acute, in view of the well publicized deliberate disassembly of certain encapsulated medicaments and the inclusion therein of certain poisons such as cyanide. This deliberate act was successfully accomplished because the capsules were inadequately sealed and gave no evidence of their tampering. That is, the slip fit engagement between the capsule halves was easily disrupted and the cap part of the capsule was removed, so that the intruder was able to insert a small but lethal quantity of poison or other disruptive agent therein.

The events described above have spurred a renewed interest on the part of the industry and the public at large to develop methods and associated apparatus to render these capsules tamper-proof by the placement of appropriate indicators of tampering on the capsule. One such approach to this problem has been known for some time, and is disclosed in U.S. Patent No. 1,861,047. In this patent, a circular band of hardened gelatin is disposed about the seam that occurs between the respective capsule halves comprising the body and the cap part that receives it. The application of the hardened gelatin band is presumed to act as a capsule seal and tamper indicator, to indicate when the capsule parts have been separated so that evidence of tampering is visually apparent.

The procedure outlined in the '047 patent and the capsules treated thereby have been found to be deficient, however, as it was possible to separate the body part from the cap part, modify the contents thereof and thereafter replace the cap and body parts in position against each other and reband the rejoined capsule so as to avoid detection of tampering.

Further deficiencies in the aforementioned technique relate to the material used to form the band. Generally, gelatin is utilized and it is found that the application thereof is difficult to control, with the result that the bands initially applied are frequently irregular, split, intermittent in extent and generally non-uniform in appearance. Also, the application of the gelatin band tends to introduce moisture into the capsule contents which in the instance of most capsule ingredients causes instability, and correspondingly drastically reduces shelf life of the contents. Likewise, if the drying system utilized in conjunction with the application of the gelatin band fails to function properly, excessive wetting of the capsule at the site of the band and consequent capsule deformation, particularly after large quantities of capsules are discharged into a holding drum, in accordance with conventional manufacturing practice, accentuates capsule deformation and results in increased numbers of capsule rejects.

Another bonding technique in broad use presently, is essentially a branding procedure, wherein a heated probe is applied against the outer surface of the capsule cap portion with sufficient pressure to urge it against the adjacent wall of the capsule body, and to cause both to melt superficially and thereby bond to each other.

This technique has the drawback that it frequently causes capsule deformation, by virtue of the localized heating which can contribute to increased frequency of capsule rejects. Likewise, the nature of the bond formed by this procedure is extremely local and renders the capsule vulnerable to undetectable violation, as with a scalpel or needle probe, to facilitate disengagement of the capsule halves for introduction of an adulterant.

Both of the aforementioned techniques are also inefficient and costly, as the equipment in the instance of the banding technique, is extremely expensive and limited in its rate of output. Likewise, the equipment utilized in the branding technique is complex, as one must have in addition to the branding equipment, a separate low speed machine for the purpose of holding the capsules during the branding process.

In a related EP—A—0 127 105, a method for permanently sealing capsules is disclosed which utilizes capillary infiltration of the interstitial space between the overlapping walls of the assembled capsule. One of several suitable adhesion-promoting fluids for the capsule wall material is applied and thereby located within the interstitial space, after which the capsules are exposed to dielectric energy, such as by microwave heating, to bond the contiguous capsule walls to each other. The adhesion-promoting fluids include liquids having high dielectric constants, such as lower alcohols.

In conjunction with this new technique it has been determined that an apparatus would be desirable that would facilitate the rapid, uninterrupted sealing of large numbers of capsules on a commercial scale. As no such apparatus capable of continuously performing the aforesaid operations is known, the present invention is believed to provide an apparatus that is particularly responsive to this need.

Summary of the Invention

In accordance with the present invention, an apparatus is disclosed for the permanent bonding of the telescoping halves of capsules prepared for resinous materials, and comprises a longitudinally extended base having an infeed end and a discharge end; a conveyor means mounted on the base and extending from the infeed end to the discharge end, for the movement of capsules disposed thereon; capsule dispenser means for holding a quantity of capsules to be treated, located in communication with the infeed end; fluid applicator means for applying an adhesion-promoting fluid to the outer surface of said capsules located downstream of said capsule dispensing means; at least one capsule washing means for applying washing liquid to remove excess adhesion-promoting fluid from said capsules, said at leat one capsule washing means being located downstream of said applying means; drying means downstream of said capsule washing means; dielectric energy means located downstream of said drying means; and collecting means located downstream of said dielectric energy applying means, for collecting and either holding or otherwise handling the finished capsules.

The capsule dispenser means may comprise a hopper into which the unsealed capsules are charged for uniform distribution along the conveyor means. In such instance, a vibrating adjustable hopper may be utilized. The fluid applicator means may comprise a spray dispenser assembly having a dispenser head with at least one and preferably multiple dispenser ports, positioned to direct a spray of adhesion-promoting fluid against the capsules as they pass by the spray dispenser assembly on the conveyor means. Alternately, the fluid applicator means may comprise a fluid bath containing a quantity of the adhesion-promoting fluid and the conveyor means may be adapted to pass through the bath. In similar fashion, the capsule washing means may utilize similar assemblies to the fluid applicator means. Moreover, both or all units may be identical or different as indicated, within the scope of the invention.

The drying means of the invention may comprise an air tunnel through which the conveyor means would pass, and air circulating means, such as a fan or blower may be associated with the tunnel to assure that a constant flow of air passes therethrough. Where desirable, a heater may be associated with the air circulating means so that heated air is utilized in the air tunnel. In such instance, a temperature regulator may be included so that temperature may be varied to suit the specific capsules being treated.

The dielectric energy means may comprise an oven with a chamber having an inlet and outlet end positioned to permit the conveyor means to pass through the chamber. A dielectric energy emitter such as a radio frequency unit or microwave heating unit is located within the chamber and positioned to direct the respective form of wave energy against the capsules as they pass through, to promote the bonding of the adjacent capsule halves.

The collecting means may be a receptacle or other capsule handling equipment, in the instance where the capsules are immediately transferred from the present apparatus to another station where they are packaged and shipped. Alternately, the collecting means may be a receptacle for holding a quantity of capsules after they are processed. In the instance where the capsules contain liquids, the collecting means may be adapted for transfer of the capsules to the infeed end of the apparatus, to permit the treatment of the capsules to be repeated.

In a further embodiment, the conveyor means may comprise a single conveyor or plural conveyors. In the latter embodiment, a first conveyor may extend from the infeed end in communication with the dispenser means, and beyond the drying means to a discharge end. A second conveyor may be positioned in communication with the discharge end of the first conveyor and adapted to pass through the dielectric energy means. A particular construction illustrated herein, positions the second conveyor beneath the first conveyor with its direction of travel adapted to be opposite to that of the first conveyor and in the direction of the infeed end of the latter.

Additional equipment may be included in accordance with the present invention. For example, the fluid applicator means may be provided with fluid chillers, solvent recovery tanks and washing systems, in the instance where continuous commercial operation is involved, and, with respect to the chiller systems, it is desired to apply the adhesion-promoting liquid at a lowered temperature. Multiple capsule washing stations may be employed to assist in the removal of excess adhesion-promoting fluid dispensed by the fluid applicator means.

Similarly, the drying means may be constructed with a variety of components, and may operate by vacuum, infrared heat or simply the circulation of warm air, for the purpose of removing the remaining traces of adhesion-promoting fluid and washing fluids, as will be described hereinafter.

The present sealing apparatus is capable of high speed operation, and may process as many as 1 million capsules per hour. The apparatus is of simple construction and operation, so that maintenance and other operating costs are favorably minimized. Moreover, the employment of dielectric heating with power units that may range between 10 and 15 kW, assures that energy

requirements are likewise favorably reduced. The present apparatus is naturally most effective when utilized in accordance with the method outlined in the earlier referenced copending European Application.

Accordingly, it is a principal object of the present invention to prepare an apparatus for sealing telescopically assembled capsules.

It is a further object of the present invention to provide an apparatus as aforesaid that operates rapidly and achieves a permanent bond between the respective overlapping capsule halves.

It is a still further object of the present invention to provide an apparatus as aforesaid that is of simple construction and operation.

It is a still further object of the present invention to provide an apparatus as aforesaid that is inexpensive to operate.

Other objects and advantages will become apparent to those skilled in the art from a review of the ensuing description considered with reference to the following illustrative drawings.

Brief Description of the Drawings

FIGURE 1 is a schematic view of an apparatus in accordance with the present invention.

FIGURE 2 is a perspective view of an apparatus in accordance with an alternate embodiment of the present invention.

Detailed Description

Referring now to the drawings, and initially to Figure 1, the capsule sealing apparatus of the present invention comprises a longitudinally extended base 2 having an infeed end 4 and a discharge end 6. A conveyor means 8 is mounted upon base 2 and extends from infeed end 4 to discharge end 6 as shown. A capsule dispenser means 10 is shown above infeed end 4 and is thereby adapted for communication with conveyor 8. Capsule dispenser means 10 may hold a quantity of capsules not shown herein, and is adapted to discharge a uniform number of such capsules onto the conveyor means 8.

A fluid applicator means 12 communicates with conveyor means 8 and is positioned downstream of capsule dispenser means 10. Fluid applicator means 12 applies an adhesion-promoting fluid to the capsules as they travel therepast. At least one capsule washing means such as capsule washing means 14 is positioned adjacent and downstream of fluid applicator means 12, in communication with conveyor means 8. Capsule washing means 14 is adapted to dispense a quantity of a washing fluid or other solvent that will remove the excess of adhesion-promoting fluid applied by the fluid applicator means 12. In an alternate embodiment, discussed in greater detail later on, plural capsule washing means 14 are present, the first in sequence used to dispense a fluid to assist in the removal of the adhesion-promoting fluid, and the next in sequence serving to remove all treatment fluids from the outer surfaces of the capsules.

The present apparatus also includes a drying means 16 likewise communicating with the conveyor means 8 and disposed downstream of capsule washing means 14. Drying means 16 is provided to remove the excess moisture or fluid that may remain either outside or within the capsules after they emerge from capsule washing means 14. A dielectric energy means 18, located downstream of drying means 16 and in similar communication with conveyor means 8 is positioned to receive the dried capsules emerging from drying means 16, and to expose the capsules to dielectric energy to cause the bonding of the adjacent overlapping capsule wall surfaces, in accordance with the technique outlined hereinafter. Lastly, a collecting means 20 is disposed in communication with discharge end 6 and thereby receives the capsules emerging from dielectric energy means 18, for storage, shipment or further processing.

Referring further to Figure 1 in detail, the present apparatus is schematically depicted, and the base 2 can be seen to comprise an essentially longitudinally extended table or the like offering a continuous horizontal support for the present apparatus. The conveyor means 8 comprises an endless belt 22 which may be motor actuated by means not shown herein. Likewise, the specific conveyor means may vary in accordance with the differing conveyor constructions already known and commercially available. No attempt is therefore made herein to set forth a specific conveyor as the present invention is not limited to a particular conveyor construction for its operation.

Capsule dispenser means 10 may comprise a hopper 24 which is provided with a conventional constriction at the bottom thereof for the release of capsules upon belt 22. In particular, a vibrating hopper may be chosen and used, which is adapted by its operation to dispense a uniform, single layer of capsules upon belt 22. In this way, each of the capsules is likely to receive the same treatment as it passes through the apparatus.

The fluid applicator means 12 comprises a fluid spray dispenser assembly 26, having a dispenser manifold 28 positioned so as to extend over belt 22. One or more dispenser ports 30 (one only illustrated) are provided along manifold 28 and are adapted to direct a spray of adhesion-promoting fluid downward against the capsules as they are fed past assembly 26.

Spray assembly 26 may be covered by a spray shield 32 as illustrated, that may be appropriately vented in a manner not illustrated herein, to prevent the undue generation of airborne effluent in the instance where it is desirable to limit the escape of the adhesion-promoting fluid into the atmosphere. In the instance where the adhesion-promoting fluid is explosive as in the instance where hexane or petroleum ether are utilized, the entire spray dispenser assembly 26 can be appropriately enclosed and made explosion-proof by appropriate insulation, and by the installation of other safety equipment known in the art.

Spray dispenser assembly 26 may also include a solvent tank 34 that would operate in conjunction with dispenser manifold 28, to provide a

constant, and if desired, recirculating supply of the adhesion-promoting fluid. In such latter instance, appropriate drains may be disposed adjacent belt 22, to permit excess adhesion-promoting fluid to run off and to return to solvent tank 34.

Capsule washing means 14 may be similarly constructed to capsule dispenser means 10, and may therefore include a spray dispenser assembly 36, a dispenser manifold 38, a dispenser port 40, a spray shield 42 and a solvent tank 44. Each of these components would operate in like manner to the comparable components discussed above with respect to fluid applicator means 12, with the only difference being that, at this station, a quantity of a washing fluid or solvent would be sprayed over the outer surface of the capsules to remove excess adhesion-promoting fluid, leaving the adhesion-promoting fluid in the desired location between the capsule halves.

As discussed earlier, plural capsule washing means 14 may be employed where a first wash with a solvent of the adhesion-promoting fluid is desirable to initiate the removal of the latter from the capsules. Thereafter, the capsules can be finally washed with a washing fluid as in accordance with the procedure already discussed, to remove all adhesion-promoting fluid and in this instance additional solvent, from the surfaces of the capsules.

Thus, while a single capsule washing means is illustrated, it is to be understood that a second spray dispenser assembly such as assembly 36 may be positioned along belt 22 downstream from assembly 36 as illustrated, so that the illustrated assembly 36 would apply the solvent solution for the adhesion-promoting fluid, and the second spray dispenser assembly would apply the washing fluid or solvent as discussed earlier on herein. Thus, while the installation of plural capsule washing means 14 is not illustrated as such installation per se is believed to be within the skill of the art, the provision of the plural units as discussed above is within the scope of the invention.

While both fluid applicator means 12 and capsule washing means 14 have been illustrated herein with reference to a spray dispenser assembly, it is possible that the respective stations may comprise treatment tanks or troughs through which the conveyor bearing the capsules may pass. In such instance, the conveyor may be modified in a number of conventional ways to assure that the capsules remain uniformly dispersed as they pass through the bath. For example, belt 22 may have a series of regularly spaced, transverse partitions or barriers, to assure that a regular number of capsules remain within a given area on the belt. Alternately, the belt may pass through the bath at an extremely slight acute angle, so that the capsules would be unlikely to congregate on the conveyor and, perhaps to fall off the conveyor and into the bath. Thus, while not specifically shown herein, the present invention is believed to include within its scope alternate fluid dispensing means to those illustrated herein.

Referring to Figure 1, drying means 16 located downstream of the capsule washing means 14, receives the fluid-treated capsules and removes excessive moisture from their surfaces. Drying means 16 comprises an air tunnel 46 that extends longitudinally over belt 22, and provides for the circulation of a flow of air past the capsules to dry them out. Tunnel 46 as illustrated, develops a flow of air (shown by the small arrows) that is countercurrent to the direction of travel of the capsules along belt 22 (belt travel direction illustrated by the larger arrow). Thus, tunnel 46 has an inlet plenum 48 which, while not illustrated herein as such, may be of increased size, to receive the initial flow of circulating air therein. Similarly, outlet or exhaust plenum 50 is located at the opposite end of tunnel 46 and represents the point at which the air flow is recirculated or otherwise exhausted.

Tunnel 46 as illustrated in Figure 1 is a recirculating system, having a circulating means or blower 52 positioned adjacent inlet plenum 48. Optionally, a heating means or heater coil 54 may be positioned upstream of blower 52, in the instance where it is desired to circulate heated air through tunnel 46. Heating means 54 may be appropriately regulated by a thermostat, not shown herein, so that the exact temperature of the circulating air may be precisely controlled. In this way drying temperatures may be modified to suit different capsule products being sealed. Also, the relatively moisture-laden air leaving tunnel 46 may be appropriately dried out by passage through heating means 54, so that, if desired, drying means 16 may operate in closed-loop fashion. Naturally, however, the invention is not limited to this specific construction and operation, as the tunnel 46 may receive heated air from a separate source and may not necessarily operate by air recirculation.

Dielectric energy means 18 is located to receive conveyor belt 22 as shown, to cause the final bonding of the capsules, in accordance with a process described briefly later on herein. Dielectric energy means 18 comprises a dielectric oven 56 having an oven inlet 58 and an oven outlet 60 that are adapted to receive belt 22 bearing the capsules thereon. The interior of oven 56 comprises an oven chamber 62 having a dielectric energy emitter 64 shown schematically. A variety of dielectric ovens may be suitable for the purpose of sealing capsules, and, for example, dielectric energy emitter 64 may be adapted for the emission microwave energy, or radio frequency wave energy, at a variety of energy levels. In the instance where gelatin capsules containing powdered medicaments are being sealed, the energy emitter 64 may be set to emit energy through a range of 10 to 15 kW. This level has been found to be sufficient for a throughput of 1 million capsules per hour, which is a substantially greater processing capacity than is available with

any apparatus known presently. Capsule residence time is extremely brief and the capsules emerging from oven 56 are completely sealed.

After emerging from dielectric energy means 18, the capsules reach discharge end 6 where they are deposited in a collecting means 20, which may be simply a receptacle 66. From this point, the capsules may be stored for further processing or may be transferred for packaging and shipment. In the instance where capsules containing various liquids have been treated by passage through the present apparatus, it may be desirable to repeat the treatment a plurality of times to assure 100% fluid-tight sealing of the capsule halves. In such instance, the collecting means 20 may comprise a conveyor or other transport means not shown herein, that may automatically return the treated capsules to capsule dispenser means 10 for a further pass through the apparatus. The specific construction of such an alternate collecting means may vary within the scope of the present invention.

The apparatus illustrated schematically in Figure 1 and described in detail above is but one embodiment of the present invention. Referring now to Figure 2 an alternate embodiment of the invention, however clearly within its scope is illustrated in perspective. Referring now to Figure 2, an apparatus is shown which utilizes as its primary distinction from the apparatus of Figure 1, two conveyors as part of the conveyor means 8. Thus, a first conveyor 72 is shown which is disposed on an independent primary base 74 and extends from an infeed end 76 commencing just before hopper 78, and extending to a discharge end 80, situated beyond air tunnel 82. A second conveyor 84 is shown that extends below first conveyor 72 and is adapted to travel in the opposite direction, through dielectric oven 86, where it terminates at a collector 88. Second conveyor 84 has an infeed end 90 which is adapted to receive the capsules from discharge end 80, and a discharge end 92 from which the finally treated capsules may pass to collector 88. As shown, discharge end 80 and infeed 90 may be provided with appropriate discharge chute 94 and receiving chute 96, respectively mounted on discharge end 80 and infeed end 90 to facilitate the passage of capsules from the first conveyor 72 to the second conveyor 84. Similarly, the apparatus shown in Figure 2 may be constructed so that dielectric oven 86 provides part of the support for primary base 74 at the discharge end 80 of first conveyor 72.

In other respects, however, the apparatus illustrated in Figure 2 is generally similar in operation, as the fluid applicator means 98 and capsule washing means 100 are comparable in construction and operation to the like structures illustrated in Figure 1. The perspective view of Figure 2 permits a better view of the dispenser manifolds 102 and 104, so that a plurality of respective dispenser ports 106 and 108 can be seen. Likewise, air tunnel 82 is better illustrated so that inlet plenum 110 and exhaust plenum 112 are more accurately depicted. While air tunnel 82 is not shown with appropriate heating or air recircularing means, it is to be understood that it can be fitted with these elements in a manner similar to that illustrated in Figure 1, so that the disclosure and discussion earlier presented herein is applicable hereto.

Referring further to Figure 2, the respective conveyors 72 and 84 are shown with schematically illustrated actuating means or motors 114 and 116 which in accordance with conventional conveyor construction, would be operatively connected to the respective conveyors by a drive roller such as rollers 118 and 120, respectively. In other respects, the construction of conveyors 72 and 84 is in accordance with conventional equipment of this type, and no specific claim is made to the conveyor construction apart from the environment of the present invention.

The operation of the apparatus of the present invention will now be described with reference to a particular method for sealing capsules. Thus, a quantity of capsules may be fed into the capsule dispenser means or hopper, and may thereafter be released in a one-capsule layer along the belt of the conveyor. For most capsule sealing applications, the belt width may be 18 inches.

The capsules are then fed to the fluid applicator means where they are passed through the spray dispenser assembly and under the dispenser ports. At this point, a quantity of an adhesion-promoting fluid such as methanol, or a mixture of methanol and carbon tetrachloride, may be applied to the capsules to infiltrate the space between the adjacent capsule halves.

The capsules pass immediately from the fluid applicator means to the capsule washing means, where in one embodiment, a similar spray dispenser assembly releases a quantity of a washing fluid, such as hexane, petroleum ether or carbon tetrachloride. This fluid is applied to remove the excess adhesion-promoting fluid remaining on the outer surfaces of the capsules, to prevent any subsequent damage to the capsule walls.

In the alternate embodiment discussed earlier, plural capsule washing means or spray dispenser assemblies may be provided, in the instance where a first washing fluid is to be applied to assist in the removal of adhesion-promoting fluid. For example, when the adhesion-promoting fluid is a solution of water and isopropanol, a first washing fluid of pure isopropanol may be applied to assist in removing the isopropanol solution from the surfaces of the capsules. Thereafter, a washing liquid such as carbon tetrachloride, hexane and petroleum ether may be sprayed on the capsules to remove any remaining adhesion-promoting fluid, as well as residual solvent utilized as the first washing fluid. Similarly, if the adhesion-promoting fluid comprises a suspension of gelatin in methanol, one may apply methanol as a first washing fluid, followed by application of a second washing fluid selected from carbon tetrachloride and the like.

After emerging from the capsule washing

means, the capsules enter the drying tunnel where they are exposed to a flow of air which may, as illustrated herein, be in countercurrent relationship to the direction of travel of the capsules. In a particular embodiment, the drying tunnel may be 6 feet in length and may utilize an air flow of 800 cfm, and a temperature ranging from 90° to 100°C. The residence time of the capsules in the drying tunnel is usually on the order of 1 minute or less, as this is sufficient time to successfully evaporate or volatize off any excess and unwanted fluids that may be present on the outer surfaces of the capsules.

The capsules then travel through the dielectric energy means which, as indicated earlier, may operate at an energy emission level of from 10 to 15 kW, to generate sufficient heat to achieve the sealing or bonding of the capsule walls to each other. In this connection, the adhesion-promoting fluid may be one having a high dielectric constant, so that the exposure to dielectric energy achieves a localized solubilization or solvation of the adjacent capsule walls, and thereby forms a firm weld or bond that is both tamper-proof and fluid-tight. In this connection and as described earlier, the capsules may be passed through the present apparatus a plurality of time to achieve complete, fluid-tight bonding of the capsule walls, in the instance where the capsules contain various liquids.

After emerging from the dielectric energy means, the capsules are fed to the discharge end of the conveyor, where they are deposited in an appropriate collecting means, such as the receptacle and alternate structures described earlier. Alternately, in the instance where residual moisture is believed to remain in the capsules, a further drying means may be disposed between the dielectric energy means and the collecting means, so that the capsules may be subjected to a further drying cycle. Such drying means may be of the type illustrated herein, or may comprise a vacuum drying apparatus, infrared heat generating apparatus or other means known for this purpose. The present invention is intended to embrace all of these alternate drying means within its scope.

The apparatus described and illustrated in Figures 1 and 2 may be further modified in the instance where specific treatments must be employed. Thus, in the instance of certain capsules wherein the adhesion-promoting fluid and the washing fluid tend to discolor or otherwise adulterate the capsule walls, it may be desirable to dispense the adhesion-promoting fluid at a temperature which may be lowered to on the order of −20°C. In such instance, the fluid applicator means may be modified to include a fluid chilling system such as a refrigeration or heat exchange coil, to pre-cool the adhesion-promoting fluid to the desired temperature prior to the application of the fluid to the capsules. Similarly, and as illustrated, the fluid applicator means and capsule washing means may utilize solvent recovery systems, including solvent tanks and other recirculating means, to conserve the respective fluids, and to avoid unnecessary release of these fluids into the surrounding working environment.

From the foregoing, it can be seen that the present apparatus is of simple construction and operation. The nature of the apparatus and the process that it performs make it possible to achieve the high volume of capsule processing indicated earlier. Thus, when the conveyor belt is operated at a speed of from 20 to 80 feet per minute and the other operating parameters specified above are observed, it has been found that a wide variety of capsules may be processed in quantities of up to 1 million capsules per hour. Naturally, various parameters of specific capsule formulations will vary, and the present apparatus can be modified accordingly.

It is understood that the invention is not limited to the illustrations described and shown herein, which are deemed to be merely illustrative of the best modes of carrying out the invention, and which are suitable of modification of form, size, arrangement of parts and details of operation. The invention rather is intended to encompass all such modifications which are within the scope as defined by the claims.

Claims

1. An apparatus for sealing capsules comprised of telescopically engaging capsule halves, said apparatus characterized by:

A. a longitudinally extended base (2; 74) having an infeed end (4; 76) and a discharge end (6; 92);

B. conveyor means (8; 72, 84) movably mounted on said base (2; 74) and extending from said infeed end (4; 76) to said discharge end (6; 92);

C. capsule dispenser means (10; 78) communicating with said conveyor means (8; 72, 84) at said infeed end (4; 76), for discharging a uniform number of said capsules on to said conveyor means (8; 72, 84);

D. a fluid applicator means (12; 98) communicating with said conveyor means (8; 72, 84) and downstream of said capsule dispenser means (10; 78), for applying an adhesion-promoting fluid to said capsules;

E. at least one capsule washing means (14; 100) communicating with said conveyor means (8; 72, 84) and downstream of said fluid applicator means (12; 98), for applying washing liquid to remove excess adhesion-promoting fluid from said capsules;

F. drying means (16; 82) communicating with said conveyor means (8; 72, 84) and downstream of said capsule washing means (14; 100);

G. dielectric energy means (18; 86) communicating with said conveyor means (8; 72, 84) downstream of said drying means (16; 82) for promoting the bonding of said capsule halves to each other; and

H. collecting means (20; 88) for the sealed capsules, located downstream of said dielectric

energy means (18, 86) and communicating with said discharge end (6; 92).

2. The apparatus of claim 1 characterised in that said capsule dispenser means (10; 78) comprises a vibrating hopper (24; 78).

3. The apparatus of Claim 1 characterised in that said fluid application means (12; 98) comprises a fluid spray dispenser assembly (26; 98) with at least one dispenser port (30; 106), positioned to direct said adhesion promoting fluid against the capsules on said conveyor means (8; 72, 84).

4. The apparatus of Claim 1 characterised in that said capsule washing means (14; 100) comprises a fluid spray dispenser assembly (36, 100) with at least one dispenser port (40; 108) positioned to direct a spray of a washing fluid against the capsules on said conveyor means (8; 72, 84).

5. The apparatus of Claim 1 characterised in that said drying means (16; 82) comprises an air tunnel (46; 82) through which said conveyor means (8; 72, 84) passes and air circulating means (52) connected to said tunnel (46; 82) for passing a flow of air therethrough.

6. The apparatus of Claim 5 characterised in that said drying means (16; 82) includes air heating means (54) associated with said air circulating means (52).

7. The apparatus of Claim 1 characterised in that said dielectric energy means (18; 86) comprises an oven (56) having a chamber (62), an inlet (58) and an outlet (60), said inlet (58) and outlet (60) positioned for said conveyor means (8; 72, 84) to pass through said chamber (62); and a dielectric energy emitter (64) within said chamber (62) located to direct dielectric energy against said capsules as they pass through said chamber.

8. The apparatus of Claim 7 characterised in that said dielectric energy emitter (64) comprises a microwave heating unit.

9. The apparatus of Claim 7 characterised in that said dielectric energy emitter (64) comprises a radio frequency heating unit.

10. The apparatus of Claim 1 characterised in that said conveyor means (8) comprises an endless belt (22) extending from said infeed end (4) to said discharge end (6).

11. The apparatus of Claim 1 characterised in that said collecting means (20; 88) comprises a receptacle.

12. The apparatus of Claim 1 characterised in that said conveyor means comprises:

A. a first conveyor (72) having an infeed end (76) and extending from said capsule dispenser means (78), beyond said drying means (82), where there is defined a discharge end (80); and

B. a second conveyor (84) having an infeed end (90) communicating with the discharge end (80) of said first conveyor (72), said second conveyor (84) communicating and extending beyond said dielectric energy means (86) to a discharge end (92) communicating with said receptacle.

13. The apparatus of Claim 12 characterised in that said second conveyor (84) said dielectric energy means (86) and said receptacle (88) are located beneath said first conveyor (72) and extend in direction toward the infeed end (76) of said first conveyor (72).

14. The apparatus of Claim 1 or Claim 12, characterised by plural capsule washing means with a first capsule washing means downstream from said fluid applicator means (26; 98), and successive of said capsule washing means downstream from said first capsule washing means and from each other.

15. The apparatus of Claim 14, characterised by two capsule washing means.

Patentansprüche

1. Vorrichtung zum Schließen von Kapseln, die aus aufeinandergeschobenen Kapselnhälften bestehen, gekennzeichnet durch:

A. ein sich längserstreckendes Untergestell (2; 74) mit einem Zuführende (4; 76) und einem Abgabeende (6; 92);

B. eine Fördereinrichtung (8; 72, 84), die auf dem Untergestell (2; 74) bewegbar angebracht ist und sich von dem Zuführende (4; 76) zu dem Abgabeende (6; 92) erstreckt;

C. einer Einrichtung (10; 78) zur Kapselausgabe, die mit der Fördereinrichtung (8; 72, 84) an dem Zuführende (4; 76) in Verbindung steht, um eine gleichmäßige Anzahl von Kapseln an die Fördereinrichtung (8; 72, 84) abzugeben;

D. eine Einrichtung (12; 98) zum Aufbringen eines Fluids, die mit der Fördereinrichtung (8; 72, 84) in Verbindung steht, und nach der Einrichtung (10; 78) angeordnet ist, um ein adhäsionsförderndes Fluid auf die Kapseln aufzubringen;

E. mindestens eine Einrichtung (14; 100) zum Waschen der Kapseln, die mit der Fördereinrichtung (8; 72, 84) in Verbindung steht und nach der Einrichtung (12; 98) zum Aufbringen eines Fluids angeordnet ist, um zum Entfernen überschüssigen adhäsionsfördernden Fluids von den Kapseln eine Waschflüssigkeit aufzubringen;

F. eine Trocknungseinrichtung (16; 82), die mit der Fördereinrichtung (8; 72, 84) in Verbindung steht und nach der Einrichtung (14; 100) zum Waschen der Kapseln angeordnet ist;

G. eine Einrichtung (18; 86) zum Aufbringen von dielektrischer Energie, die mit der Fördereinrichtung (8; 72, 84) in Verbindung steht und nach der Trocknungseinrichtung (16; 82) angeordnet ist, um die Bindung der Kapselhälften aneinander zu fördern; und

H. eine Sammeleinrichtung (20; 88) für die geschlossenen Kapseln, die nach der Einrichtung (18; 86) zum Aufbringen dielektrischer Energie angeordnet ist und mit den Abgabeende (6; 92) in Verbindung steht.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung (10; 78) zur Kapselausgabe einen schwingenden Einfüllbehälter (24; 78) aufweist.

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung (12; 98) zum Aufbringen des Fluids eine Anordnung (26; 98) zur Abgabe von Fluidsprühnebel mit mindestens

einer Abgabeöffnung (30; 106) aufweist, die ausgerichtet ist, um das adhäsionsfördernde Fluid gegen die Kapseln auf der Fördereinrichtung (8; 72, 84) zu richten.

4. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung (14; 100) zum Waschen der Kapseln eine Anordnung (36, 100) zur Abgabe von Fluidsprühnebel mit mindestens einer Abgabeöffnung (40; 108) aufweist, die ausgerichtet ist, um einen Sprühnebel von Waschfluid gegen die Kapseln auf der Fördereinrichtung (8; 72, 84) zu richten.

5. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Trocknungseinrichtung (16; 82) einen Luftkanal (46; 82), durch den die Fördereinrichtung (8; 72, 84) hindurchführt, aufweist, und eine Einrichtung (52) zum Umwälzen von Luft, die mit dem Kanal (46; 82) verbunden ist, um durch diesen einen Luftstrom hindurchzufördern.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die Trocknungseinrichtung (16; 82) eine Einrichtung (54) zum Aufheizen von luft umfaßt, die mit der Einrichtung (52) zum Umwälzen der Luft in Verbindung steht.

7. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung (18; 86) zum Aufbringen dielektrischer Energie einen Ofen (56) mit einer Kammer (62), einem Einlaß (58) und einen Auslaß (60) aufweist, wobei der Einlaß (58) und der Auslaß (60) so ausgerichtet sind, daß die Fördereinrichtung (8; 72, 84) durch die Kammer (62) hindurchführt, und in der Kammer (62) einen Sender (64) für dielektrische Energie aufweist, der ausgerichtet ist, um dielektrische Energie gegen die Kapseln zu richten, wenn diese die Kammer durchlaufen.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß der Sender (64) für dielektrische Energie eine Radiofrequenzeinheit aufweist.

9. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß der Sender (64) für dielektrische Energie eine Radiofrequenzeinheit aufweist.

10. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Fördereinrichtung (8) ein endloses Band (22) aufweist, das sich von dem Zuführende (4) zu dem Abgabeende (6) erstreckt.

11. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Sammeleinrichtung (20; 88) einen Aufnahmebehälter aufweist.

12. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Fördereinrichtung aufweist:

A. ein erstes Förderband (78) mit eine Zuführende (76), das sich von der Einrichtung (78) zur Ausgabe von Kapseln über die Trocknungseinrichtung (82) hinaus erstreckt, wo ein Abgabeende (80) festgelegt ist; und

B. eine zweites Förderband (84) mit einem Zuführende (90), das mit dem Abgabeende (80) des ersten Förderbandes (72) in Verbindung steht, wobei das zweite Förderband (84) mit der Einrichtung (86) zum Aufbringen dielektrische Energie in Verbindung steht und sich über diese hinaus bis zu einem Abgabeende (92) erstreckt, das mit dem Aufnahmebehälter in Verbindung steht.

13. Vorrichtung nach Anspruch 12, dadurch gekennzeichnet, daß das zweite Förderband (84), die Einrichtung (86) zum Aufbringen dielektrischer Energie und der Aufnahmebehälter (88) unter dem ersten Förderband (72) angeordnet sind und sich in Richtung auf das Zuführende (76) des ersten Förderbandes (72) erstrecken.

14. Vorrichtung nach Anspruch 1 oder 2, gekennzeichnet durch mehrere Einrichtungen zum Waschen der Kapseln, wobei eine erste Einrichtung zum Waschen der Kapseln nach der Einrichtung (26; 98) zum Aufbringen des Fluids angeordnet ist und nach der ersten Einrichtung zum Waschen der Kapseln nacheinander Einrichtungen zum Waschen der Kapseln angeordnet sind.

15. Vorrichtung nach Anspruch 14, gekennzeichnet durch zwei Einrichtungen zum Waschen der Kapseln.

Revendications

1. Appareil pour sceller des capsules formées de deux moitiés de capsules engagées télescopiquement l'une dans l'autre, caractérisé en ce qu'il comprend:

a) un bâti longitudinal (2; 74) avec une extrémité d'entrée (4; 76) et une extrémité de sortie (6; 92),

b) un convoyeur (8; 72, 84) monté sur bâti (2; 74) et allant de ladite extrémité d'entrée (4; 76) à ladite extrémité de sorti (6; 92), et, d'amont en aval,

c) un distributeur de capsules (10; 78) communiquant avec ladite entrée (4; 76) dudit convoyeur (8; 72, 84) pour distribuer uniformément lesdites capsules sur ledit convoyeur (8; 72, 84),

d) un applicateur de fluide (12; 98) communiquant avec ledit convoyeur (8; 72, 84), pour appliquer un fluide d'activation d'adhésivité auxdites capsules,

e) au moins un moyen de lavage (14; 100) communiquant avec ledit convoyeur (8; 72, 84), pour appliquer un liquide de lavage afin d'éliminer l'excès de fluide d'activation d'adhésivité desdites capsules,

f) un moyen de séchage (16; 82) communiquant avec ledit convoyeur (8; 72, 84),

g) un moyen de production d'énergie diélectrique (18; 86) communiquant avec ledit convoyeur (8; 72, 84), pour activer le scellement desdites moitiés de capsule l'une à l'autre, et

h) un collecteur (20; 88) pour les capsules scellées, communiquant avec ladite extrémité de sortie (6; 92).

2. Appareil selon la revendication 1, caractérisé en ce que ledit distributeur de capsules (10; 78) est une trémie vibrante (24; 78).

3. Appareil selon la revendication 1, caractérisé en ce que ledit applicateur de fluide (12; 98) est un atomiseur (26, 98) avec au moins une buse (30; 106), orientée de telle façon que le jet de fluide

d'activation d'adhésivité soit dirigé contre les capsules sur ledit convoyeur (8; 72, 84).

4. Appareil selon la revendication 1, caractérisé en ce que ledit moyen de lavage (14; 100) est un atomiseur (36; 100) avec au moins une buse (40; 108) orientée de telle façon que le jet de fluide de lavage soit dirigé contre les capsules sur ledit convoyeur (8; 72, 84).

5. Appareil selon la revendication 1, caractérisé en ce que ledit moyen de séchage (16; 82) est un tunnel à air (46; 82) dans lequel passe ledit convoyeur (8; 72, 84), un moyen pour faire circuler l'air (52) étant relié audit tunnel (46, 82) pour y produire un courant d'air.

6. Appareil selon la revendication 5, caractérisé en ce que ledit moyen de séchage (16; 82) comprend un moyen pour chauffer l'air (54) associé audit moyen (52).

7. Appareil selon la revendication 1, caractérisé en ce que ledit moyen de production d'énergie diélectrique (18, 86) est un four (56) comportant une chambre (62) avec une entrée (58) et une sortie (60) par lesquelles passe le convoyeur (8; 72, 84) dans ladite chambre (62), et un émetteur d'énergie diélectrique (64) dans ladite chambre (62), dirigeant l'énergie diélectrique contre lesdites capsules lorsqu'elles passent dans ladite chambre.

8. Appareil selon la revendication 7, caractérisé en ce que ledit émetteur d'énergie diélectrique (64) est un élément de chauffage à micro-ondes.

9. Appareil selon la revendication 7, caractérisé en ce que ledit émetteur d'énergie diélectrique (64) est un élément de chauffage à haute fréquence.

10. Appareil selon la revendication 1, caractérisé en ce que ledit convoyeur (8) est un tapis sans fin (22) allant de ladite extrémité d'entrée (4) à ladite extrémité de sortie (6).

11. Appareil selon la revendication 1, caractérisé en ce que ledit collecteur (20; 88) est un réceptacle.

12. Appareil selon la revendication 1, caractérisé en ce que ledit convoyeur comprend:

a) un premier convoyeur (72) passant sous le moyen de séchage (82), avec une extrémité d'entrée (76) communiquant avec le distributeur de capsules (78) et une extrémité de sortie (80), et

b) un second convoyeur (84) passant sous ledit moyen de production d'énergie diélectrique (86), avec une extrémité d'entrée (90) communiquant avec l'extrémité de sortie (80) dudit premier convoyeur (72) et une extrémité de sortie (92) communiquant avec ledit réceptacle.

13. Appareil selon la revendication 12, caractérisé en ce que ledit second convoyeur (84), ledit moyen de production d'énergie diélectrique (86) et ledit réceptacle (88) sont placés sous ledit premier convoyeur (72), dirigés vers l'extrémité d'entrée (76) dudit premier convoyeur (72).

14. Appareil selon la revendication 1 ou 12, caractérisé en ce qu'il comporte une pluralité de moyens de lavage, avec un premier moyen de lavage en aval dudit applicateur (26; 98) et les autres moyens de lavage en aval dudit premier moyen de lavage, à la suite les uns des autres.

15. Appareil selon la revendication 14, caractérisé en ce qu'il comporte deux moyens de lavage.

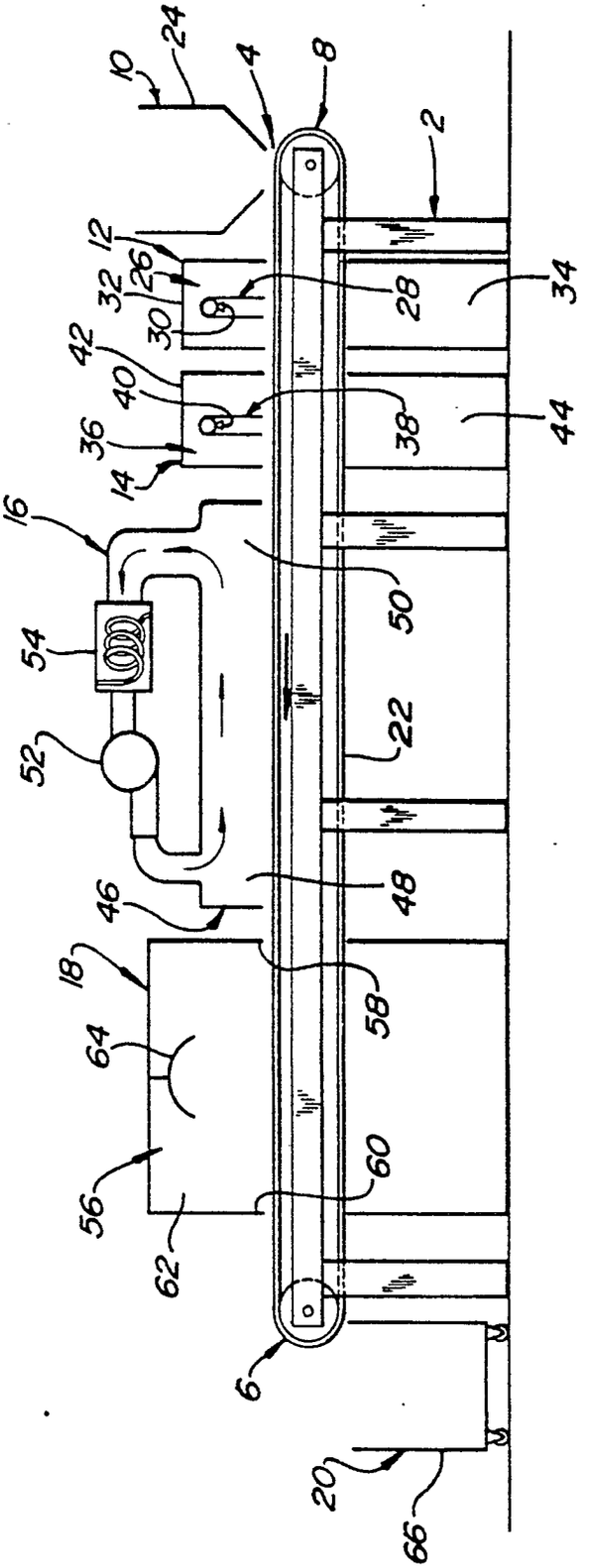
10
24
4
8
2
12
26
32
30
28
34
42
40
36
38
44
14
16
50
54
52
22
46
48
18
58
64
60
56
62
6
20
66

FIG-1

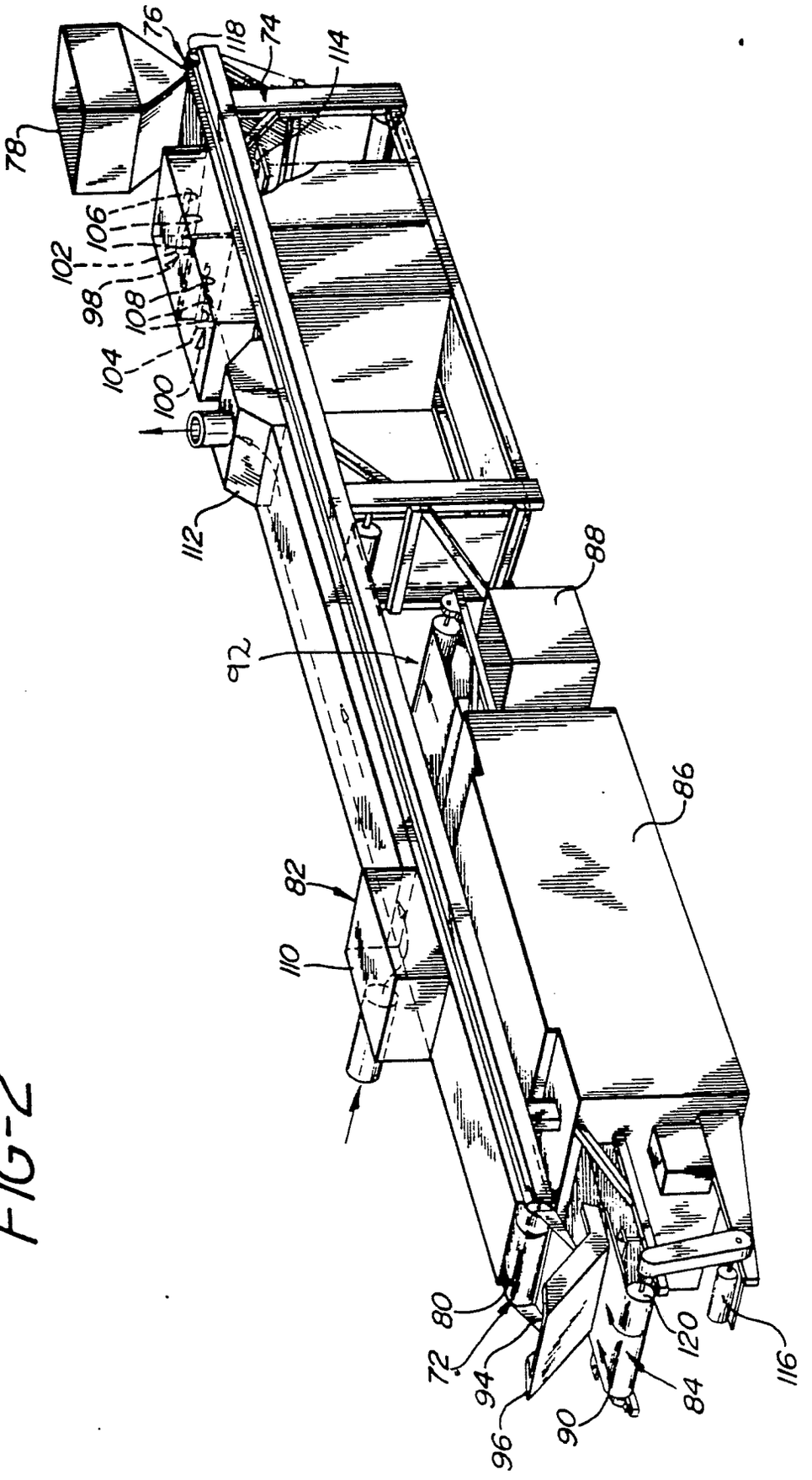
76
118
74
114
78
106
102
98
108
104
100
112
88
92
86
82
110
80
72
94
96
90
84
120
116

FIG-2