Jan. 6, 1953 C. E. FISHER, JR 2,624,069

METHOD AND APPARATUS FOR FABRICATING SEAMLESS CAPSULES

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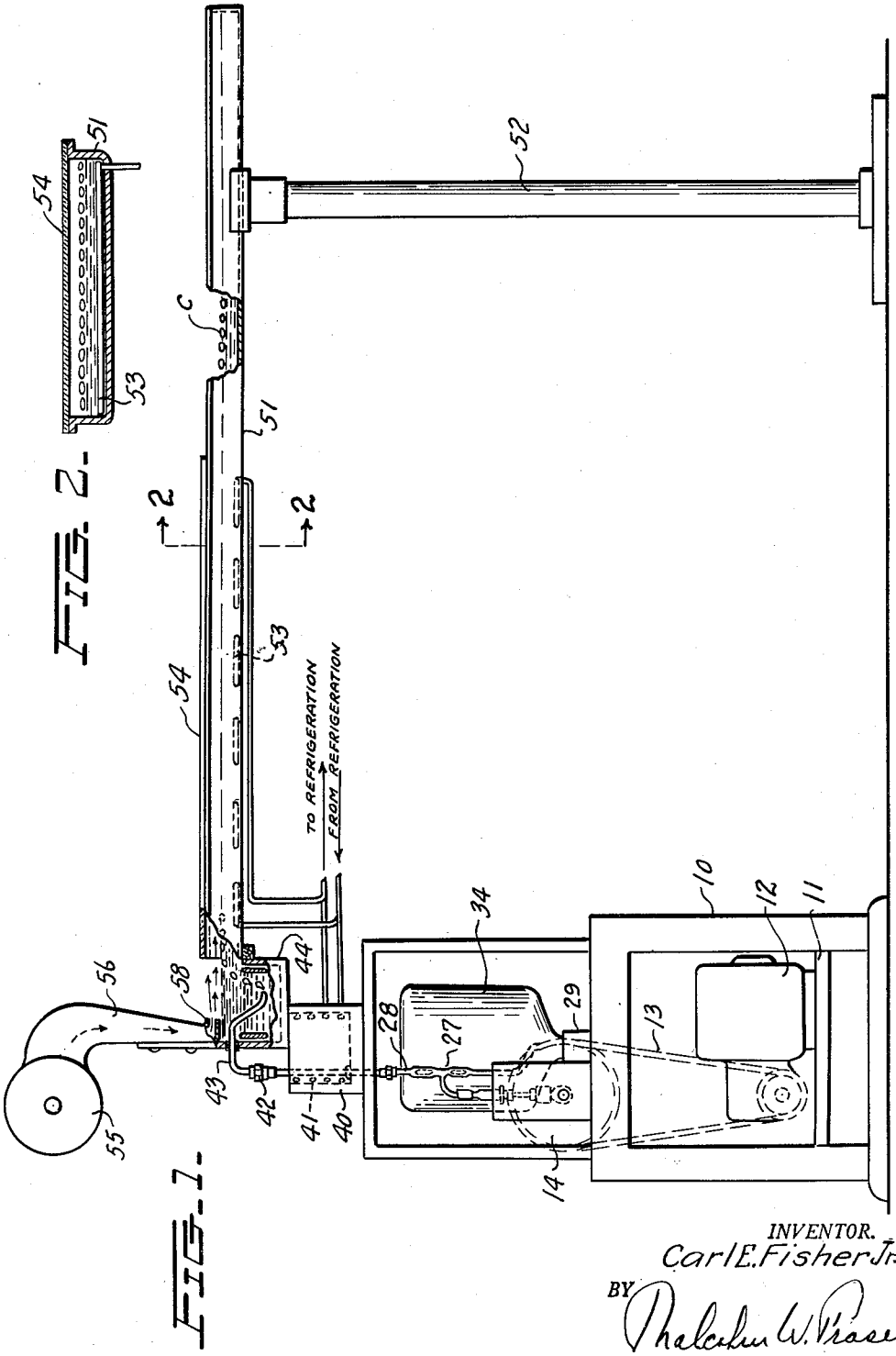

FIG. 2.

FIG. 1.

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FIG. 3.

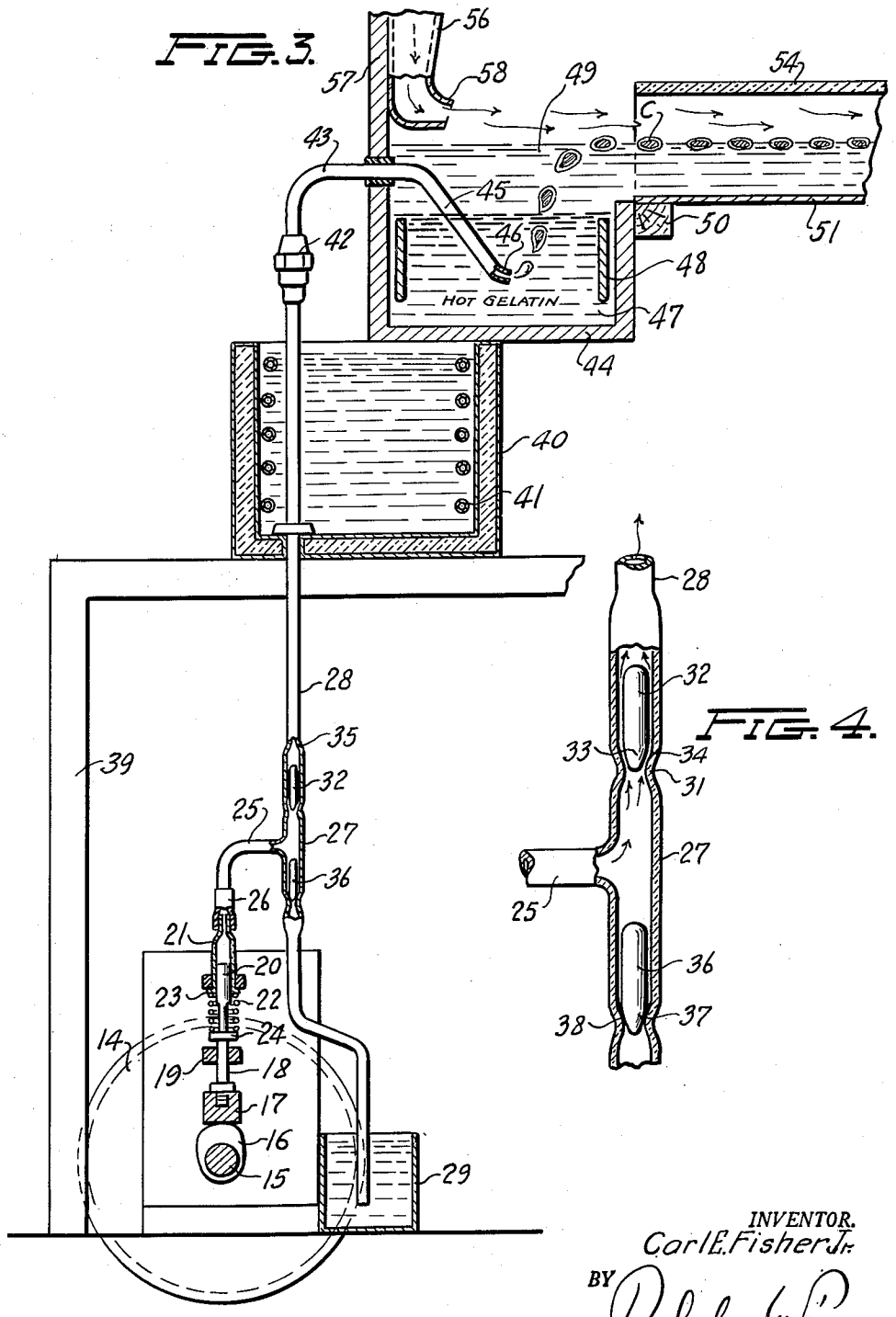

FIG. 4.

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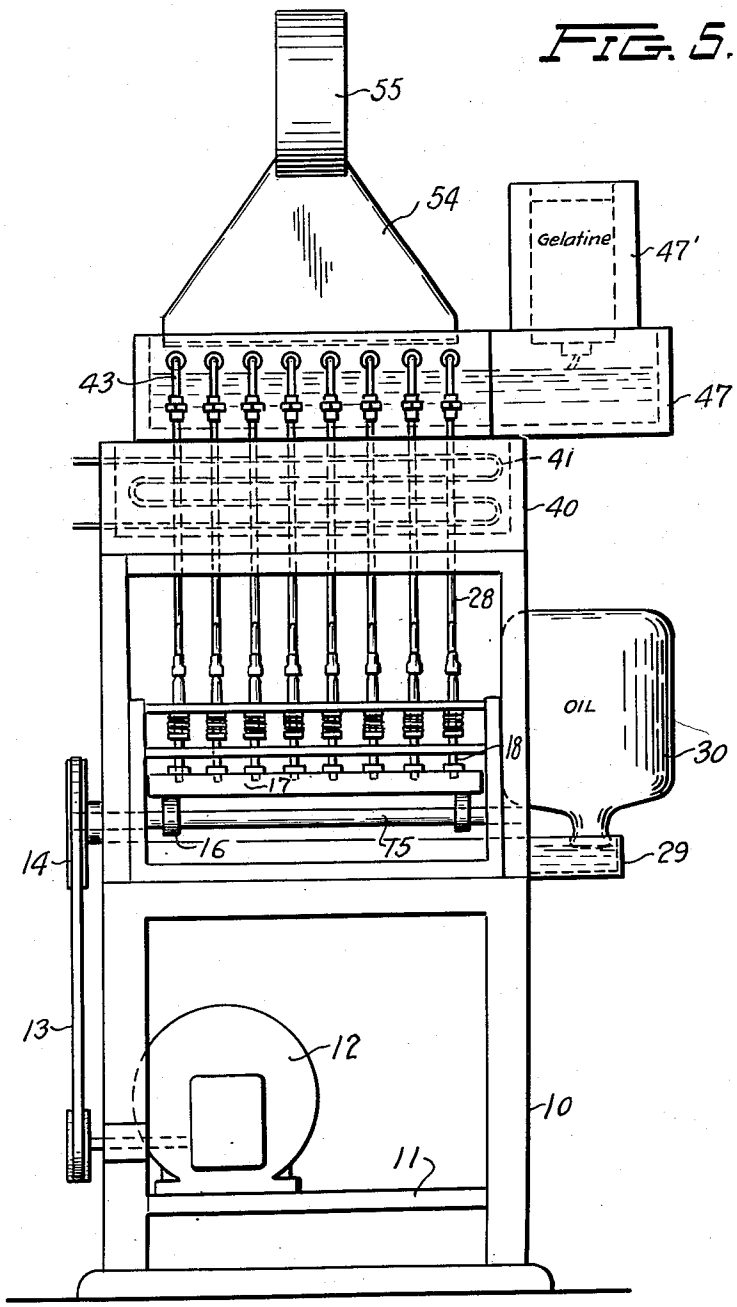
FIG. 5.



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METHOD AND APPARATUS FOR FABRICATING SEAMLESS CAPSULES

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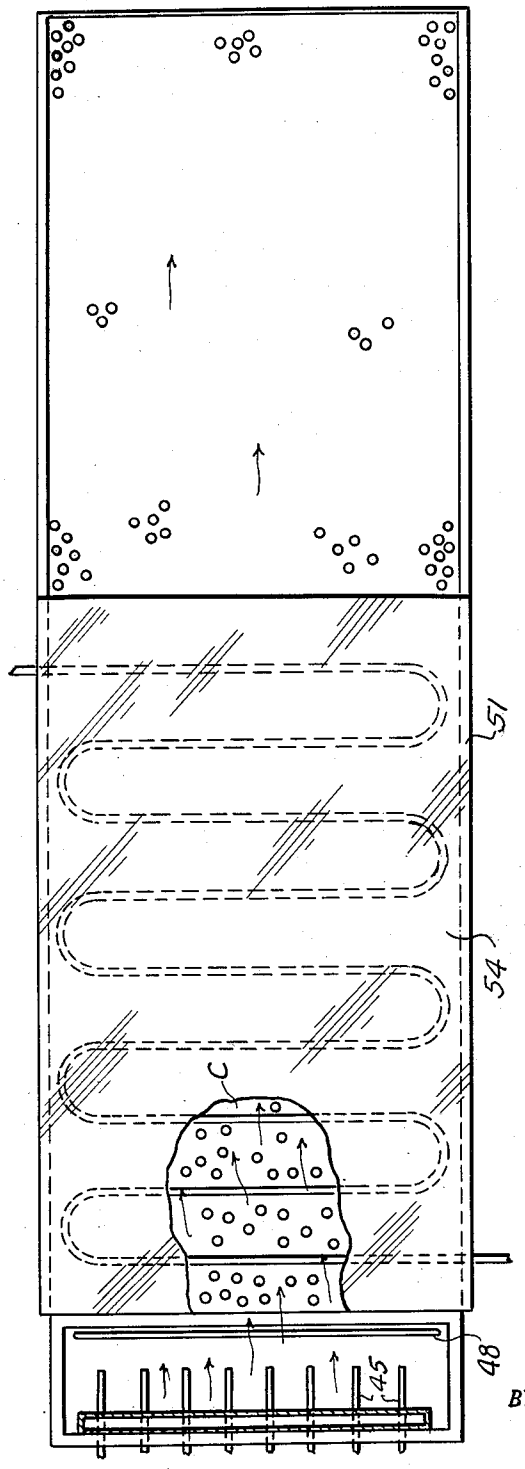
FIG. 6.



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UNITED STATES PATENT OFFICE

2,624,069

METHOD AND APPARATUS FOR FABRICATING SEAMLESS CAPSULES

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Application October 8, 1948, Serial No. 53,439

12 Claims. (Cl. 18—5)

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This invention relates to the manufacture of capsules, but more particularly to the production of seamless capsules.

This invention is concerned with a capsulating method and apparatus of the order shown and described in the United States patents to Robert W. Gunnell, Nos. 2,342,661 and 2,428,911. According to the capsulating method shown and described in those patents, the content material, for example, in liquid form, is refrigerated and then introduced into a chamber containing a heated congealable capsulating material, such, for example, as gelatin sol, where the cold content material collects its own coating. Due to the differences in specific gravity, the capsule rises to the top of the capsulating material and enters a relatively cold column of liquid. Due to gravity differences, the capsule rises to the surface of the cooling and conditioning liquid from which it is removed.

An object of this invention is to produce a new and improved capsulating apparatus which is simple in design, efficient in operation, and is capable of producing capsules on a commercial basis so that each capsule is substantially the same as another.

Another object is to improve the delivery of liquid content material to the capsule coating liquid in such manner as to insure that each capsule is supplied with the same amount of content material or liquid.

A further object is to produce new and improved means for handling capsules after they have been formed in order to militate against damage or injury to same and to expedite the delivering of same.

A still further object is to produce an improved method of forming capsules and handling same.

Other objects and advantages of the invention will hereinafter appear, and for purposes of illustration but not of limitation, an embodiment of the invention is shown on the accompanying drawings, in which

Figure 1 is a side elevation of a capsulating apparatus, some parts being broken away in the interest of clarity;

Figure 2 is a transverse sectional view on the line 2—2 of Figure 1;

Figure 3 is an enlarged elevation, partly in section, of the apparatus, and particularly the pumping device, capsule forming and capsule propelling device;

Figure 4 is an enlarged fragmentary elevation partly in section of the pumping chamber;

Figure 5 is an end elevation of the apparatus; and

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Figure 6 is a top plan view of the apparatus showing particularly the pneumatic propelling device and trough through which the formed capsules pass.

The illustrated embodiment of the invention comprises a supporting table 10 provided with a shelf 11 on which is mounted an electric motor 12. The motor 12, through suitable reduction gearing, drives a sheave about which is trained an endless belt 13 for driving a sheave 14 fixed to a shaft 15 to which is secured a cam 16. Engaging the cam 16 is a bar 17 fixed to a vertically reciprocable rod 18 which is guided in its vertical movements by a suitable stationary bracket 19. On the upper end portion of the rod 18 is a pump plunger 20 which is vertically reciprocable within a cylindrical tube 21. A helically coiled spring 22 is interposed between a flange 23 on the end of the tube 21 and a collar 24 which is fixed to and reciprocable with the rod 18. It will be manifest that the cam 16 is so designed that it forces the plunger 20 upwardly within the cylindrical tube 21 and the coil spring 22 retracts the plunger in accordance with the conformation of the cam 16.

Preferably the tube cylinder 21 is of metal, and providing a connection between the restricted upper end portion of the tube cylinder 21 and a branch tube 25 is a flexible sleeve coupling 26. The branch coupling 25 is bent at substantially right angles and is integral with a tubular enlargement 27 which forms a part of a vertically disposed tube 28. The lower portion of the tube is bent laterally and then extends vertically into a container 29 which contains liquid content material for the capsules, such, for example, as vitamin containing oil. An inverted bottle 30 is provided to maintain the level of the liquid within the container 29 constant as will be readily understood.

The tube enlargement 27 provides a feed chamber for the content material, as will hereinafter appear, and above the chamber is a construction 31 and disposed therein is an elongate cylindrical member or check valve 32 having a tapered lower end portion 33 which, when in its downward position, seats against the conical surface 34 in the tube, thereby to provide a seal. Spaced vertically above the constriction 31 is a constriction 35 which limits the upward movement of the cylindrical member or check valve 32. It will be observed that the outside diameter of the check valve 32 is substantially less than the inside diameter of the tube in which it operates, so that liquid may be forced past the check valve through the upper end of the tube 28 when the chamber

formed by the enlargement 27 is subjected to pressure. A similar cylindrical check valve 36 is disposed in the lower portion of the enlargement 27 and similarly has a tapered or conical lower end 37 to seat against a valve seat 38 formed by a constriction in the tube.

In operation, it will be manifest that when the plunger 20 is forced upwardly, pressure is created within the feed chamber comprehended by the enlarged tube portion 27, thereby to force any liquid therein upwardly past the check valve 32 which is unseated, around the valve 32 and upwardly through the tube 28. At the same time, the pressure within the feed chamber forces the check valve 36 to its seat, preventing downward movement of the liquid therein. On the other hand, when the plunger 20 moves downwardly, a suction is created within the feed chamber thereby causing the check valve 32 to move downwardly to its seated position, and drawing the valve 36 upwardly, thereby sucking a portion of the capsule content material from the container 29 upwardly through the tube and into the feed chamber. Thus alternately, liquid content material from the container 29 is drawn into the feed chamber and forced from the feed chamber upwardly through the tube 28.

As shown particularly on Figure 5, the shaft 15 carries a pair of cams 16 which operate against the bar 17 and connected to the bar is a plurality of rods 18 for actuating the pump plungers 20 as above described. However, since each is similarly constructed, a description of one will suffice, it being understood that the number of pumps and associated parts may be varied, as desired, each operating recurrently to draw content material from a common reservoir or container 29.

Mounted on the table 10 is a supporting structure 39 through which the upper end portion of each of the tubes 28 passes and then extends into a refrigerating unit 40, which may be a brine tank having a series of refrigerating coils 41 therein. In this manner, the content material is refrigerated during its upward passage through the tube 28. The tube 28 extends through the refrigerating unit 40 and connected to the upper end by a coupling 42 is a tube 43 which extends laterally through an aperture in the side wall of a tank 44, the end portion inclining downwardly as indicated at 45 and terminating in a slightly bent nozzle portion 46. The tank 44 contains a congealable capsulating material 47, such, for example, as gelatin sol which is heated by electrical heating units 48. A constant level is maintained within the tank 44 from a vertically disposed supply tank 47'.

Reference is hereby made to the United States patents to Gunnell above mentioned for a more complete discussion of the capsulating material as well as the content material. As there explained, the globules of the content material are recurrently forced from the nozzle 46 and due to their refrigerated state, gradually collect a coating of the capsulating or coating material and rise due to the difference in specific gravity, to the surface of the capsulating material and then the capsules enter a superposed column of cooling or conditioning liquid 49. The liquid 49 is immiscible with the capsulating liquid and is refrigerated as will hereinafter appear, so that the formed capsules not only rise to the surface of the conditioning liquid, but gradually assume a spherical shape and the capsulating material becomes hardened so that the capsules may be conveniently handled for packing.

As shown, the tank 44 is suitably supported upon a portion of the brine tank or refrigerating unit 40 and supported at one end by a bar 50 secured to a side wall of the tank 44 is a trough 51, the opposite end of which is supported by a pedestal 52. The bottom of the trough 51 is disposed slightly above the surface of the capsulating material 47 and as shown, is partially filled with the cooling and conditioning liquid 49. Reference is again made to the above mentioned Gunnell patents regarding the cooling and conditioning liquid. It may, for example, consist of kerosene, but in any event, it must be a liquid which is not only immiscible with the capsulating liquid or gelatin sol, but must have a specific gravity such that the formed capsules will automatically rise through it and float on the surface.

Arranged within the trough 51 are refrigerating coils 53, the coils 53 and 41 being suitably connected and leading to any suitable refrigerating unit. The cover 54 is disposed over a portion of the trough 51 adjacent to the tank 44.

The capsules are pneumatically propelled along the surface of the cooling and conditioning liquid 49 and for this purpose, a blower 55 which may be of any suitable type and driven from an electric motor (not shown) is supported by an outwardly flaring vertically disposed tube 56 suitably connected to a vertical extension 57 of an end wall of the tank 44. The lower end of the tube 56 has a width approximately equal to the width of the trough 51, and terminates in a nozzle 58 positioned to direct a stream of air under pressure between the surface of the cooling and conditioning liquid 49 and the undersurface of the cover 54. This stream of air is thus confined between the cover 54 and the surface of the cooling liquid, and affords a propelling force for causing the formed capsules, as indicated at C, to move along the surface of the liquid to the right-hand end portion thereof (Figure 6) from which they may be removed for packaging. This enables the capsules to be moved out of the way of succeeding capsules discharged from the nozzles 46, in order to militate against capsules becoming adhered to each other. It will be manifest that the liability of newly formed capsules adhering to each other is great until the coating has sufficiently hardened. The passage of the capsules along the trough 51 through the cold liquid assists materially in hardening the coating so that upon reaching the end portion of the trough, the capsules not only will have attained their desired spherical form, but may remain in the cold liquid until the desired degree of hardness has been achieved.

From the above it will be apparent that I have produced an exceedingly simple apparatus and method for automatically producing seamless capsules. No handling of the capsules is necessary until the coating has sufficiently hardened. As above mentioned, the number of pumping units may be varied as desired, thus enabling a large number of capsules to be produced simultaneously from a single source of power. The pneumatic propulsion of the capsules after they have been formed, but before the coating has hardened, is exceedingly advantageous, and militates against injury to the capsules as would be the case should they be mechanically propelled. Although the tubes 28 as well as the discharge tubes 43 may be of glass, other materials may be advantageously substituted. The use of glass, however, is desirable, since it enables the tubes to be sterilized, the mounting of the tubes being

such that they can be readily removed for this purpose. The employment of the check valves above described, is found particularly meritorious because when the feed chamber is subjected to the suction stroke of the plunger **20**, the suction developed is relatively slight so that beads formed at the discharge nozzle **46** are largely obviated.

It will be observed that the cooling and conditioning liquid **49** above the gelatin sol or capsulating liquid **47** is relatively shallow and this reduces the weight of the column of cooling liquid upon the capsulating liquid to a minimum, this being helpful in making it easier to maintain a constant level of capsulating liquid. It will further be observed that the conditioning liquid **49** is not placed in circulation and that the greater volume of this liquid is segregated from the capsulating liquid **47**. This is an important feature in that it not only simplifies the apparatus, but also enables the colder liquid to be maintained through which the capsules are propelled by the air stream or blast.

It is to be understood that numerous changes in details of construction, arrangement and operation may be effected without departing from the spirit of the invention especially as defined in the appended claims.

What I claim is:

1. In a capsulating apparatus having a chamber adapted to contain superposed layers of congealable capsule forming liquid and a cooling liquid immiscible therewith and a device for introducing refrigerated content substance of lower specific gravity than the cooling and capsule forming liquids into the capsule forming liquid so that it passes upwardly through same and the cooling liquid whereby to form a capsule, and pneumatic means for propelling the formed capsules along the surface of the cooling liquid.

2. In a capsulating apparatus having a chamber adapted to contain superposed layers of congealable capsule forming liquid and a cooling liquid immiscible therewith and a device for introducing refrigerated content substance of lower specific gravity than the cooling and capsule forming liquids into the capsule forming liquid so that it passes upwardly through same and the cooling liquid whereby to form a capsule, an elongate laterally disposed trough openly communicating with the upper portion of the column of cooling liquid and containing cooling liquid, and means for creating an air stream along and parallel to the surface of the liquid in said trough for propelling capsules on the surface thereof along same.

3. In a capsulating apparatus having a chamber adapted to contain superposed layers of congealable capsule forming liquid and a cooling liquid immiscible therewith and a device for introducing refrigerated content substance of lower specific gravity than the cooling and capsule forming liquids into the capsule forming liquid so that it passes upwardly through same and the cooling liquid whereby to form a capsule, and means for creating a confined stream of air along the surface of the cooling liquid for propelling formed capsules along same.

4. Capsulating apparatus comprising a vessel adapted to contain capsule forming liquid and a superposed layer of an immiscible cooling liquid having a free top surface, means for introducing charges of liquid content material into said capsule forming liquid so as to form capsules which rise through said capsule forming and cooling liquids and float on the surface of said cooling liquid, said vessel having a lateral extension at the upper end thereof adapted to contain said layer of cooling liquid, said extension being relatively long as compared with the depth of said vessel below said lateral extension, and means for moving the capsules floating on the surface of the cooling liquid laterally along said surface.

5. The combination set forth in claim 4 wherein the area of the vessel in horizontal section at a point adjacent and below said extension is relatively small as compared with the area of said extension in horizontal section.

6. Capsulating apparatus comprising a vessel adapted to contain a capsule forming liquid in a heated condition, a trough extending laterally from the upper portion of said vessel and communicating therewith above the level of said capsule forming liquid, said trough being adapted to contain a quantity of cooling liquid extending as a layer over the capsule forming liquid in said vessel, nozzle means in said vessel below said trough for introducing into said capsule forming liquid, charges of refrigerated liquid content material so as to form capsules which rise through said capsule forming and cooling liquids and float on the surface of said cooling liquid, the depth of said trough and the depth of said vessel below said trough being relatively small as compared with the length of said trough, and means for moving the floating capsules laterally along the surface of said cooling liquid in said trough.

7. Capsulating apparatus comprising a vessel adapted to contain a capsule forming liquid in a heated condition, a trough extending laterally from the upper portion of said vessel and communicating therewith above the level of said capsule forming liquid, said trough being adapted to contain a quantity of cooling liquid extending as a layer over the capsule forming liquid in said vessel, nozzle means in said vessel below the level of said trough for introducing into said capsule forming liquid, charges of refrigerated liquid content material so as to form capsules which rise through said capsule forming and cooling liquids and float on the surface of said cooling liquid, the depth of said trough and the vertical distance between said nozzle and said trough both being relatively small as compared with the lateral extent of said trough, and means for moving the floating capsules laterally along the surface of said cooling liquid in said trough.

8. Capsulating apparatus comprising a vessel adapted to contain a capsule forming liquid in a heated condition, a trough extending laterally from the upper portion of said vessel and communicating therewith above the level of said capsule forming liquid, said trough being adapted to contain a quantity of cooling liquid extending as a layer over the capsule forming liquid in said vessel, nozzle means in said vessel below the level of said trough for introducing into said capsule forming liquid, charges of refrigerated liquid content material so as to form capsules which rise through said capsule forming and cooling liquids and float on the surface of said cooling liquid, the depth of said trough and the vertical distance between said nozzle and said trough both being relatively small as compared with the lateral extent of said trough, and means for moving the floating capsules laterally along the surface of said cooling liquid in said trough comprising means for producing a stream of air directed along the surface of the cooling liquid in said trough.

9. The method of forming capsules which comprises introducing charges of liquid content material into a quantity of capsule forming liquid having a superposed shallow layer of cooling liquid thereon which extends laterally beyond the interface between said capsule forming and cooling liquids so as to form capsules which rise through the capsule forming liquid and float on the surface of said cooling liquid and causing said capsules to travel laterally on the surface of said cooling liquid in a direction away from said interface a distance relatively great as compared with vertical distance travelled by the capsules through said cooling liquid.

10. The method of forming capsules which comprises introducing charges of liquid content material into a quantity of capsule forming liquid having a superposed shallow layer of cooling liquid thereon so as to form capsules which rise through the capsule forming liquid and float on the surface of said cooling liquid and causing said capsules to travel laterally on the surface of said cooling liquid a distance relatively great as compared with their upward travel through said cooling liquid by directing a stream of air laterally over the surface of said cooling liquid.

11. The method of forming capsules as set forth in claim 9 wherein said layer of cooling liquid is maintained in a relatively non-circulating condition and wherein said layer of cooling liquid is refrigerated in that portion thereof which extends laterally beyond the interface between said capsule forming and cooling liquids.

12. The combination set forth in claim 6 including means within said trough for refrigerating said cooling liquid.

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The following references are of record in the file of this patent:

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