APPARATUS FOR CAPSULATING LIQUIDS

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Application June 2, 1952, Serial No. 291,361

9 Claims. (Cl. 53—86)

This invention relates to new and useful improvements in apparatus for encapsulating materials and particularly materials of liquid or pasty consistency.

It is often desirable to package small amounts or single applications of materials. For example, it has been found convenient to prepare hand lotion in small, individual packets for both advertising samples and retail sale. In use, the material is squeezed from the packet and the wrapper is then discarded. Also, it has been found convenient to similarly package comestibles such as mustard and the like for individual use in applications such as picnic kits, air-line lunches, and take-away hamburger or hot-dog concessions. Other uses of the above concept will readily suggest themselves.

An important object of the invention is to provide an apparatus for making small, individual capsules or packets of materials such as the ones named specifically above.

Another object of the invention is to provide an apparatus of the above-mentioned character that is essentially rapid in operation and that produces the packets economically at a high rate of speed.

Still another object of the invention is to provide an apparatus of the above-mentioned character that produces a fluidtight and airtight packet which keeps the contents thereof essentially fresh for a relatively long time.

Yet another object of the invention is to provide an apparatus of the above-mentioned character that is substantially automatic in operation.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the drawings forming a part of this specification and wherein like numerals are employed to designate like parts throughout the same:

Fig. 1 is a perspective view of a capulating apparatus embodying the invention;

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary, elevational view of the portion of Fig. 1 designated by the arrow 4;

Fig. 5 is a fragmentary view between the forming dies of the apparatus as indicated by the line 5—5 in Fig. 7;

Fig. 6 is a fragmentary view showing a single capsule or packet of the type produced by the apparatus;

Fig. 7 is an enlarged, fragmentary, vertical sectional view taken on the line 7—7 of Fig. 1, particularly illustrating one of several identical valves which control operation of the apparatus;

Fig. 8 is a transverse sectional view taken on the line 8—8 of Fig. 2;

Fig. 9 is a fragmentary, vertical sectional view taken on the line 9—9 of Fig. 5;

Fig. 10 is a perspective view showing one of the die members used to form and seal the packet;

Fig. 11 is a view similar to Fig. 2 but showing the parts in elevation and illustrating the relationship thereof with adjacent parts of the apparatus;

Fig. 12 is a diagrammatic view illustrating the pneumatic circuit which operates the various working parts of the apparatus.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention, the numeral 20 designates an upright support disposed at the front of the machine 22. Mounted on one side of the support 20 adjacent the upper end thereof are inner and outer die members 24 and 26 carried by back-up plates 28 and 30 respectively. The back-up plates 28 and 30 are larger than die members 24 and 26, and the back-up plate 28 is fastened solidly to the support 20. Bolts 32 and 34 extend rearwardly through the back-up plates 28 and 30 at opposite sides of the die members 24 and 26. As previously mentioned, in Fig. 1, the bolts 32 and 34 extend rearwardly of the support 20 and the rearward ends thereof are connected by a crosshead 36 disposed transversely and actuated by a fluid motor 38 and 40. Springs 41 carried by the bolts 32 and 34 and confined between back-up plates 28 and 30 normally urge the latter apart so as to separate the die members.

The dies 24 and 26 are arranged opposite each other and have flat confronting surfaces each formed with medially disposed upper and lower cavities 42 and 44. The two cavities 42 and 44 are vertically aligned and separated by an intervening bridging portion 46. The upper cavity 42 extends through the upper end of the die, and the lower cavity 44 extends through the lower end thereof. Also it will be observed that the cavity 42 is relatively longer than the lower cavity 44 and in any event is sufficiently long to accommodate the entire capsule of material to be formed by the apparatus.

The entire confronting surface portions 42 and 44 of the di 20 tanguous to the cavities 42 and 44 is corrugated as at 48, and the corrugations of the two die members interfit when the dies are brought together.

Mounted on the support 20 above the die members 24 and 26 is an ejection nozzle device comprising an ejection tube 50 carried by and extending downwardly from a suitable crosshead slide 52 which extends between and is slidably supported by guides 54 and 56 and is secured to the die support 20. The upper end of the guide 54 and 56 is connected by a transverse member 58, and the entire ejection tube and slide assembly is attached to the support 20 by a pair of arms 60 and 62. As best shown in Figs. 1 and 4, the arms 60 and 62 embrace the support 20 and are securely fastened thereto by bolts 64.

The arms extend forwardly of support 20 and between guides 54 and 56 and the terminal portions thereof are suitably fastened to the guides by bolts 66. A fluid motor 68 surmounting and suitably fastened to the transverse member 59 has a downwardly extending piston rod 70 which extends through member 58 and is fastened securely to the crosshead guide 52. Manifestly, operation of the fluid motor 68 causes the guide 52 and consequently the ejection tube 50 to reciprocate vertically.

The arms 60 and 62 also extend rearwardly of the support 20 and form part of a supporting structure 72, which carries spaced rolls 74 and 76 of paper, foil, or the like from which the packets are made. Strip material from the lower roll 74 extends forwardly over a suitable guide roll 78 journaled to and extending between suitable standards 80 and 82 fastened to and opposite sides of the support 20. Strip material from the upper roll 76 similarly extends forwardly over a guide roll 84 journaled to and disposed between upright standards 86 and 88 fastened to and extending upwardly from the arms 60 and 62. The two pieces of strip material extend downwardly from the respective guide rolls 78 and 84, on opposite sides of the ejection tube 50, and between the die members 24 and 26.

Mounted on the support 20 below the die members 24 and 26 is a suitable intermittent pulling mechanism comprising inner and outer jaws 90 and 92. The inner jaw 90 is mounted for vertical sliding movement between ways 94 and 96 defined by plates 98 and 100 respectively fastened to opposite sides of the support 20. The outer jaw 92 is disposed within a generally U-shaped, forwardly extending frame 102 carried by and movable with the rearward jaw 90. A pair of laterally spaced fluid motors 104 and 106 carried by the frame 102 and fastened to the jaw are operative to move the latter to and from the stationary jaw 98. Springs 108 and 110 also interposed between and fastened to the jaw
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92 and frame 102 hold the jaws 90 and 92 normally separated. The strip material from rolls 74 and 76 extends downwardly from die members 24 and 26 between the jaws 90 and 92.

The operation of the pulling mechanism is achieved by a crank arm 112 fastened at one end to the stationary jaw 90 at the rearward side thereof and at the other end to an eccentric 114 driven by the drive shaft 116 of a motor 118. As shown in Fig. 1, the drive shaft 116 is relatively long and extends entirely through an elongated housing 120 interposed between frame 20 and the motor 118. It will readily apparent that the motor 118 acts through the drive shaft 116 to rotate the eccentric 114 and that the latter in turn acts through the crank arm 112 to move the clamping arms vertically between the ways 94 and 96.

Material to be packaged by the apparatus is kept in a suitable container 122 (Fig. 11), and this material is delivered to the ejector tube 50 in successive, measured, uniform packets by means of a pump 126 (Fig. 10). The strip material from rolls 74 and 76 extends to the valve body 142 in communication with passage 56 by a suitable coupling 162, and the valve casing is connected to the ejector cylinder 132 by a suitable union 164. As shown in Fig. 2, the union 164 is threaded into passage 160 and has a lobe 168 which connects with the ejector tube 50 of the valve body 142.

In Fig. 8, the fluid motor 186 is shown with the piston retracted in the cylinder 190 to position the valve body 130 as shown by full lines with the passage 156 in register with passage 160. When fluid pressure is admitted into cylinder 188, the piston 196 advances the latter in the cylinder, and the lobe 168 is moved to the bottom position, thereby actuating the valve body 142 to bring passage 156 into register with passage 160. The fluid pressure is thus transmitted to the valve body 142 and to the fluid motor 186.

All the fluid motors 38, 68, 104, 106, and 186 are actuated in proper timed relation by eccentric cams 198, 200, and 202 fixed to and rotatable with the drive shaft 204 and by valves 204, 206, and 208 fixed to and actuated by respective cams. The valves 204, 206, and 208 are shown mounted in a block 210 and integral with the housing 212 directly above the cams 198, 200, and 202. The passages 216 and 218 are identical in construction and operation, and a detailed description of only one therefore is given.

Each valve comprises a plunger 212 mounted for reciprocation in a sleeve 214 which is press-fitted or otherwise fixedly secured in a bore 216 extending upwardly from the bottom of block 210 (Fig. 7). Vertically spaced inlet passages 218 and 220 are provided in the block 210, and these passages align with corresponding positions of the sleeve 214. The outlet passages 222 and 224 are positioned in the opposite side of the block.

The two inlet passages 218 and 220 register with correspondingly spaced inlet ports 226 and 228 provided in the sleeve 214, and the two outlet passages 222 and 224 register with correspondingly spaced outlet ports 230 and 232 in the sleeve. The plunger 212 is formed with a diametrical passage 234 which is movable by reciprocation of the plunger selectively into register with either of the two sets of ports 226 and 228, and this passage 234 is registered in the passages of the plunger 212 above passage 234 registers at one end with outlet port 230 when the passage 234 is in register with the ports 226 and 228. The opposite end of passage 234 is registered in the passage of the plunger 212 when passage 234 is in register with the ports 226 and 228. The opposite end of L-shaped passage 238 opens...
through the bottom of the plunger. In this connection it will be observed that the plunger 214 extends downwardly from the block 210, and a cam follower 240 rotatably mounted on the lower end of the plunger engages the outer edge of plate 211. Fig. 1 shows a sectional view through the middle valve 206, and the cam follower 240 of this valve rests upon cam 200 (Fig. 1). Each valve also includes a cap 242 which is threadedly into the upper end of the valve stem 241, centrally of and above the valve plunger 212. As shown in Fig. 7, the opening 244 communicates with the open end of plunger 212 and the surrounding sleeve 214, and a spring 246 is placed between the upper end of the plunger and the upper end of the cap normally urges the plunger downwardly to assure constant engagement of the cam follower 240 with the eccentric cam which operates the valve.

The apparatus here shown is operated by air under pressure but it will be readily appreciated that it could just as well be operated hydraulically. As shown in Fig. 12, air under pressure is carried to the machine by an air line 248. Air is carried to valve 204 through a branch line 258, and the end of the latter has bifurcations 255 and 256 which connect with the two inlet passages 210 and 222 respectively. Simultaneously, as to return air is carried to valve 206 by a branch line 256, and the end of this line is provided with bifurcations 258 and 260 which connect with respective inlet passages 218 and 220 of the carburetor. The carburetor valve 205 by a branch line 262 having terminal bifurcations 264 and 266 which connect with respective inlet passages 218 and 220 of the valve 204.

The upper discharge passage 222 of valve 204 is connected to fluid motor 186 ahead of the piston therein, and the lower discharge passage 224 of the valve is connected to the same motor behind the piston by line 270. Fig. 12 shows cam 198 positioned to lift valve 204 so as to connect the conduits 259 and 268 to retract the piston in cylinder 186 and to position the elevator 130 as shown in Figs. 2 and 8. At this time the gearing connected to the motor motor 186 is reversed electrically to vent the cylinder 186 to atmosphere through conduit 279 and the L-shaped passage 238.

The upper discharge port 230 of valve 206 is connected by a conduit 272 to the cylinder of fluid motor 68 ahead of the piston therein, and the lower discharge passage 224 is connected by conduit 274 to the cylinder of motor 68 behind the piston. In Fig. 12, the valve 206 is shown raised and 276 and 278 to retract the piston in cylinder 68 and to hold the elevator nozzle 50 raised. The lower discharge port 222 of valve 206 is connected by conduits 276 and 278 to fluid motor 38 behind the piston therein to close the dies 24 and 26 and by conduits 280 and 282 to fluid motors 104 and 106 ahead of the piston 150. The cam 198 now moves the clamp and 240 so as to retract the piston 150 and 148, and 140 to hold the elevator nozzle 50 raised. The upper discharge port 222 of valve 208 is connected by conduits 284 and 286 to fluid motor 38 behind the piston therein to open the dies 24 and 26 and by conduits 284, 288, and 290 to the cylinders of fluid motors 104 and 106 behind the pistons therein to close the jaws 90 and 92.

The operation of the device is now described, and for this purpose it will be assumed that the elevator loader 130 is positioned as shown in Fig. 2, permitting material being packaged to be charged to the elevator cylinder 132, and it will be further assumed that the lobe of cam 184 is rotating away from the follower 182 so that the material forced under pressure into the elevator cylinder 132 moves the piston 176 to the left so as to introduce a full charge into the elevator cylinder. Also, it will be assumed that the elevator tube 50 is raised, that the dies 24 and 26 are open and that the ends 90 and 92 are closed. In this position of the clamping jaws, the eccentric pivot of cam 114 is at the upper limit of its travel preparatory to lowering the puller unit of which the jaws 90 and 92 are as so as to hold the clamping jaws 90 and 92 and, since the puller assembly is being moved downwardly by the eccentric cam 114 the clamping jaws 90 and 92 are open so as to hold the clamping jaws 90 and 92, and since the puller assembly is being moved downwardly by the eccentric cam 114 the clamping jaws 90 and 92 are open so as to hold the clamping jaws 90 and 92, and since the puller assembly is being moved downwardly by the eccentric cam 90 and 92. As the elevator tube 50 approaches the upper limit of its travel, cam 202 again operates valve 208 to operate the fluid motor 38 so as to open dies 24 and 26.
simultaneously to operate fluid motors 104 and 106 so as to close the clamping jaws 90 and 92. As these two operations occur simultaneously, the dies 24 and 26 are open by the time the clamping jaws 90 and 92 are fully closed, and the arrangement is such that the clamping jaws close when the puller unit has been raised to the upper limit of its travel.

Also, after the material has been charged to ejector tube 50, cam 198 again places the follower in position 7 so that the latter connects the air pressure with fluid motor 186 ahead of the piston therein. This action returns the ejector loader valve to the position shown in Fig. 2 and connects the ejector loader cylinder 132 with the container 133 and the piston 176. At about the time the dies 24 and 26 open and clamping jaws 90 and 92 close, cam 184 releases piston 176 so that another charge of material is introduced into the cylinder 174. The cam then begins to move the puller unit downwardly; and since clamping jaws 90 and 92 are together at this time, they pull strips 70 and 76 downwardly between the open dies 24 and 26. This completes the cycle of operation.

In connection with the foregoing it should perhaps be pointed out that the puller unit 100 moves the strips 74 and 76 downwardly as the pass 234 as fast as it is possible to bring the upper portion of the previously filled pocket into alignment with the lower cavities 44 of die members 24 and 26. Thus, when the die members are united during any cycle of operation except the first in any series of operations, they close and seal the pocket which was formed and filled by the prior operation and before charge of material is ejected from the tube 50. Each pocket contains a separate container of the material being packaged. Any suitable number of these packets may be folded together or, if desired, they may be separated by either automatic or manual means (not shown) incorporated as a part of the machine or subsequently either manually or automatically in any suitable or conventional manner.

It will be noted that the desirable limit of the machine operation as rapidly as possible and speeds in the order of one hundred cycles per minute have been achieved. In order to operate at such high speeds, it is necessary, in addition to the sealing of the nozzle 50 so as to prevent the upper limit of its travel in order to break or snap off the jet of material being discharged therefrom. This is particularly true in the case of a relatively viscous and pasty material. If the material is not snapped off abruptly in this manner the strips 74 and 76 moving downwardly on opposite sides of the nozzle 50 tend to pull material therefrom, resulting in faulty charging, creating a generally messy condition which may affect the sealing of the packets by the dies 24 and 26. According to the present invention breaking off of the fluid stream from the nozzle 50 is accomplished by the particular construction which controls the ejector nozzle actuator 68. By providing a cam-operated valve of the type here disclosed, air is admitted to the fluid motor 68 gradually as the pass 234 is completed with ports 226 and 230. Manifestly, a relatively small amount of air will be admitted to the ejector nozzle 50, and immediately when pass 234 begins to register with the aligned ports; and, as the pass moves more and more into register, increasing amounts of air are admitted to the fluid motor 68. Thus, initial upward movement of the nozzle 50 is relatively slow and the rate of travel is progressively increased as it moves upwardly. Maximum speed is thus achieved at the nozzle 50, and the upper movement of its travel and this change in acceleration produces the desired result described above.

Also, the use of a valve 206 to control the reciprocatory movements of the ejector nozzle 50 contributes important advantages to the operation as it provides necessary dwell periods at opposite ends of the reciprocatory travel. A dwell period when the ejector nozzle 50 is at the lower limit of its travel assures that the tube 50 is all the way down before the dies 24 and 26 are completely closed, and, as described above, this prevents the ejector tube from breaking through the strip material 74 and 76. The dwell period at the upper limit of its travel assures that the liquid material in the nozzle to stabilize itself and assures a uniform feed. It will be readily appreciated in this connection that an absolute uniform material is essential to make the machine commercially practicable.

Also, in order to achieve maximum efficiency in operation it is necessary that the dies 24 and 26 be closed essentially rapidly and open relatively slowly. In addition, it is important that stripping jacks 90 and 92 close essentially slowly and open relatively rapidly. This operation is achieved in a particularly efficient manner by the valve 206 which controls the fluid motors 184, 186 and 192. Rapid closing of the dies 24 and 26 and rapid opening of clamping jaws 90 and 92 are achieved because the pressure of air in pass 234 when it is in register with ports 226 and 230 tends to hold the plunger 212 raised. Thus, as the cam 200 begins to rotate downwardly, it moves away from the follower 240, and there is only the pressure of spring 246 to shift the plunger 212 to the lower position. This completes the cycle of operation by step each time a distance sufficient to bring the upper portion of the previously filled pocket into alignment with the lower cavities 44 of die members 24 and 26. Thus, when the die members are united during any cycle of operation except the first in any series of operations, they close and seal the pocket which was formed and filled by the prior operation and before charge of material is ejected from the tube 50. Each pocket contains a separate container of the material being packaged. Any suitable number of these packets may be folded together or, if desired, they may be separated by either automatic or manual means (not shown) incorporated as a part of the machine or subsequently either manually or automatically in any suitable or conventional manner. As a result of successive operations as described above a series of discrete small blisters or packets are formed between the strips 74 and 76. Each packet contains a separate container of the material being packaged. Any suitable number of these packets may be folded together or, if desired, they may be separated by either automatic or manual means (not shown) incorporated as a part of the machine or subsequently either manually or automatically in any suitable or conventional manner.
and simultaneously discharging a measured amount of liquid into said pocket, means for separating said die members after the tube is raised, and means for pulling said strips downwardly when said die members are separated to position the upper portions of said pocket above the level of liquid therein between the lower portions of said die members whereby the pocket is closed and sealed by the next operation of said die members.

2. The combination as set forth in claim 1 including means for gradually accelerating movement of the ejector tube as it is withdrawn from said cavity whereby maximum speed is attained at the end of the withdrawal movement.

3. The combination as set forth in claim 2 including means for holding the ejector tube still at least momentarily at the end of its travel away from said die members.

4. The combination as set forth in claim 1 including means for bringing the ejector tube to the end of its movement into the cavity before the die members are brought entirely together and for holding the tube in this position at least momentarily after the die members have closed.

5. The combination as set forth in claim 1 including means for bringing said die members together relatively quickly and for separating said die members relatively slowly.

6. The combination as set forth in claim 5 wherein the means for moving said die members comprises a fluid motor operatively connected to said die members, valve means for controlling flow of operating fluid to said motor, a rotatably driven cam coactive with said valve means to position the same for admitting fluid to the motor to separate said die members, and spring means coactive with said valve to position the same for admitting fluid to the motor to bring said die members together.

7. The combination as set forth in claim 1 wherein the means for advancing said strips of sheet material comprises grippers at opposite sides of and movable into and out of engagement with said sheet material and including means for bringing said grippers into engagement with said sheet material as said die members are separated and for moving said grippers out of engagement with said sheet material as said die members are brought together.

8. The combination as set forth in claim 7 including means for moving said grippers relatively slowly into engagement with said sheet material and for moving said grippers out of engagement with said sheet material relatively rapidly.

9. The combination as set forth in claim 8 wherein said gripper-actuating means comprises a fluid motor operatively connected to said grippers, a valve for controlling flow of operating fluid to said motor, rotatably driven cam means coactive with said valve to position the same for admitting fluid to said motor to move the grippers into engagement with said sheet material, and spring means coactive with the valve to position the same for directing fluid to the motor to move the grippers out of engagement with said sheet material.

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