

[54] **APPARATUS FOR MAKING AND FILLING
LIQUID CONTAINING PODS**

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[63] Continuation-in-part of Ser. No. 87,757, Nov. 9, 1970, abandoned.

[52] U.S. Cl. **53/180, 53/373**

[51] Int. Cl. **B65b 9/02, B65b 51/30**

[58] Field of Search **53/180, 182, 183, 53/373**

References Cited

UNITED STATES PATENTS

2,982,066 5/1961 Thompson 53/180

3,228,170 1/1966 Eisenstadt 53/182

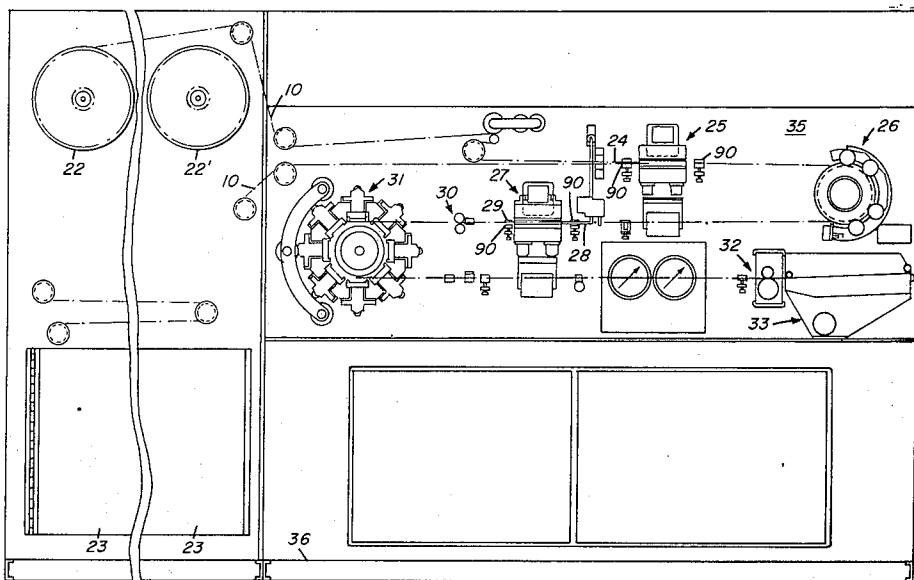
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[57]

ABSTRACT

An apparatus for forming and filling liquid containing pods which have a rupturable seal permitting release of the liquid content when the pod is subjected to a predetermined mechanical stress. Strips of laminated material are continuously formed into a plurality of liquid containing pods by advancing the strips, having a width equal to the width of the pods, through heat sealers which seal the edges of the strips to form a tubular structure which is continuously filled with a liquid after which the filled tubular structure is passed through a cross-sealer to form the end seals of the individual pods. The individual pods are chopped from the strip by cutting between the cross seals.

19 Claims, 12 Drawing Figures



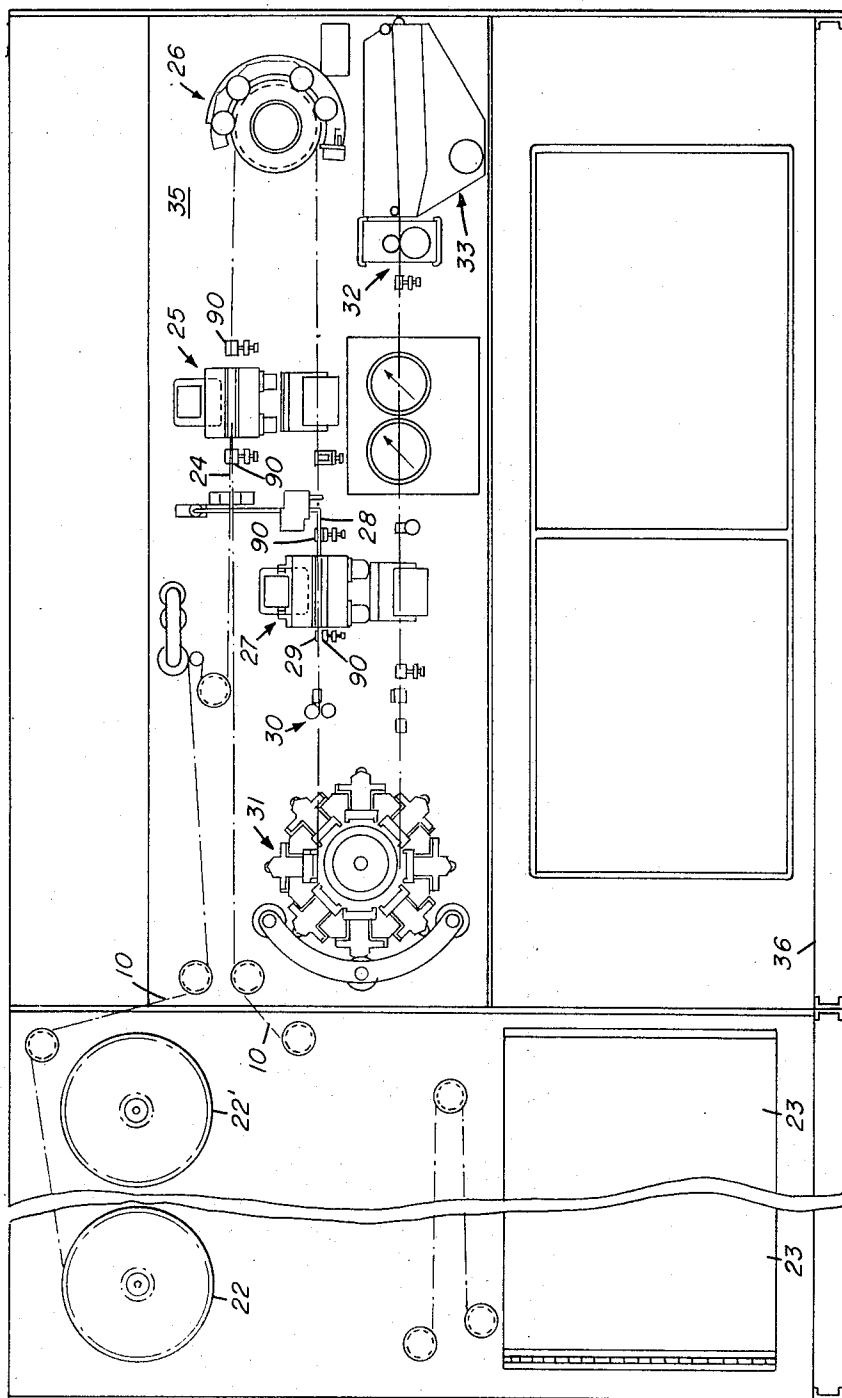


FIG. 2

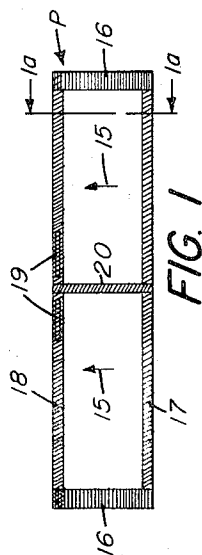


FIG. 1



FIG. 1a

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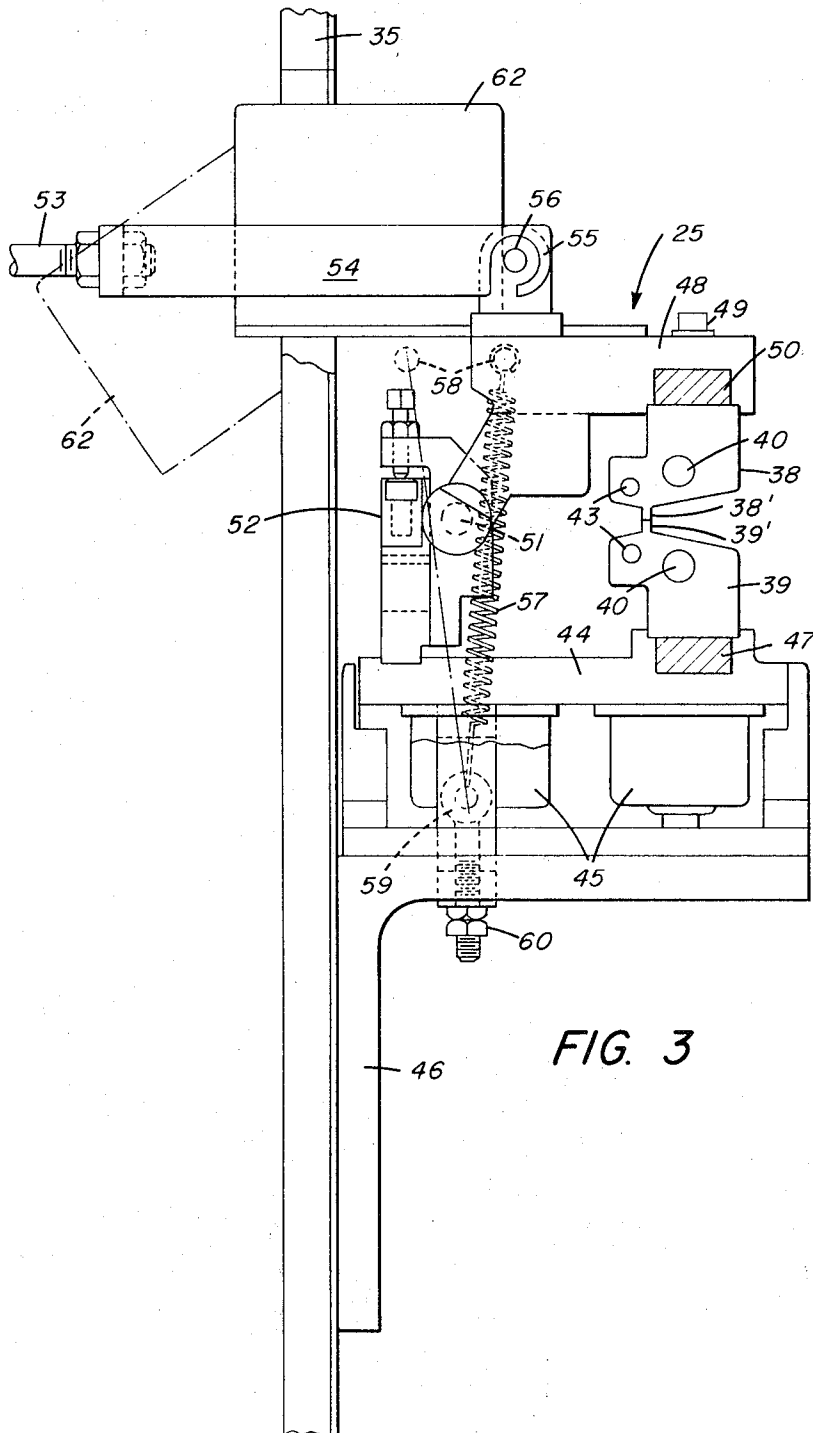


FIG. 3

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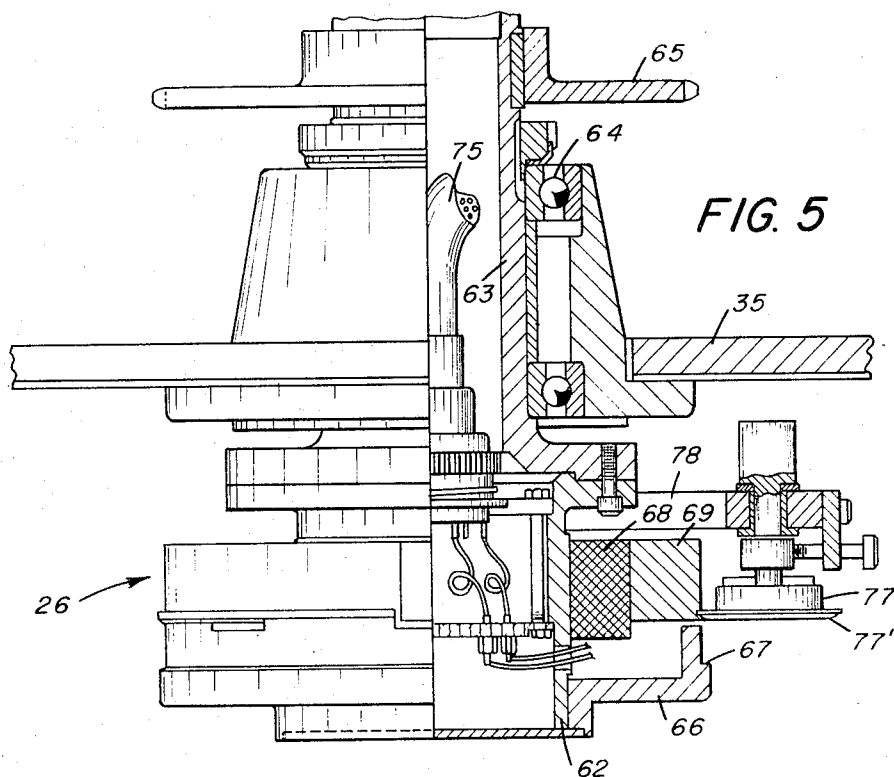


FIG. 5

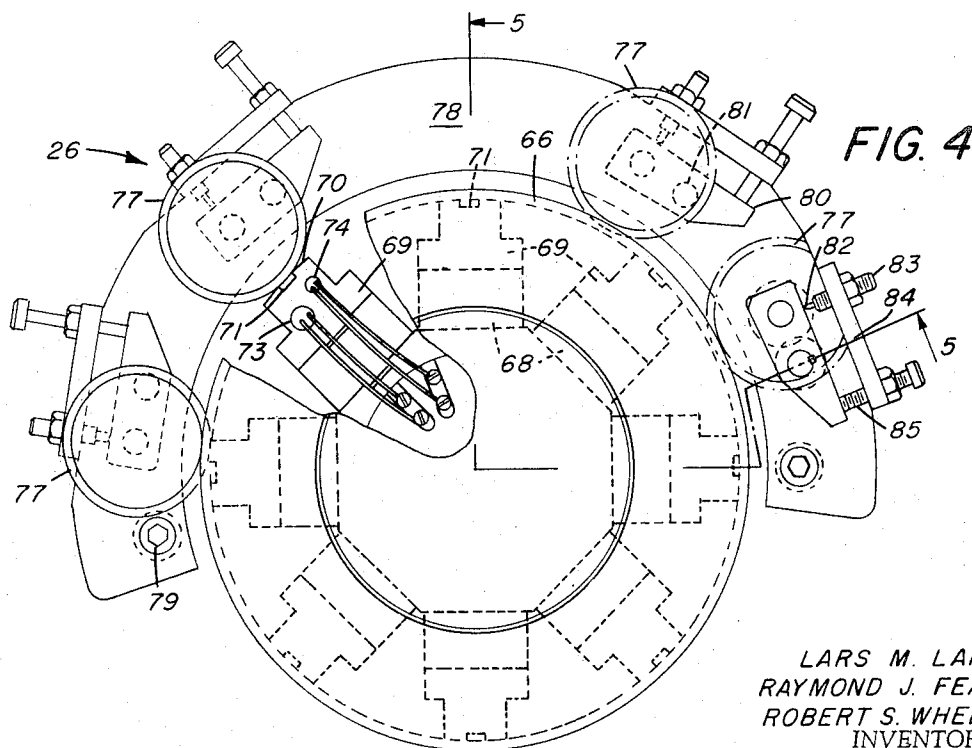
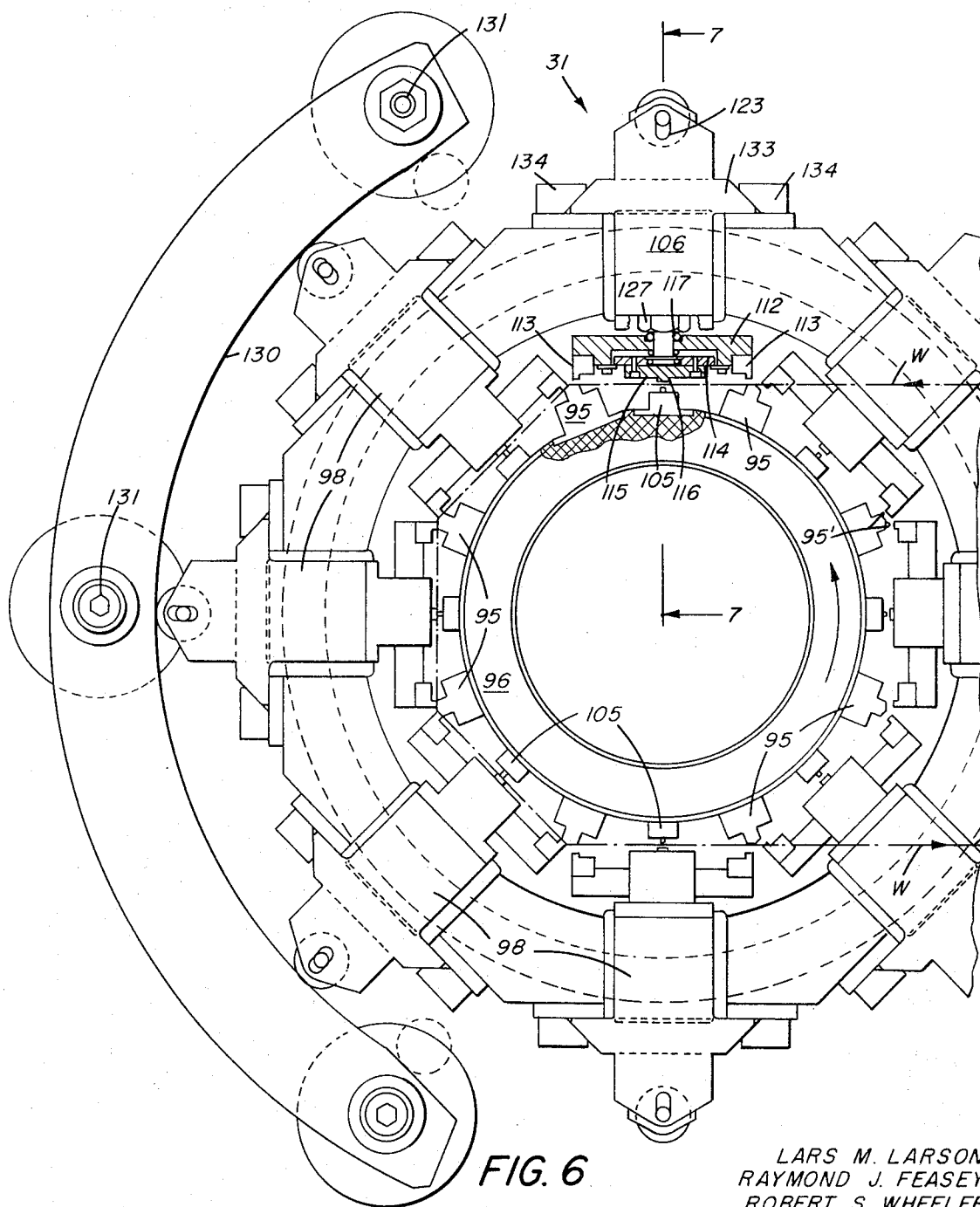


FIG. 4

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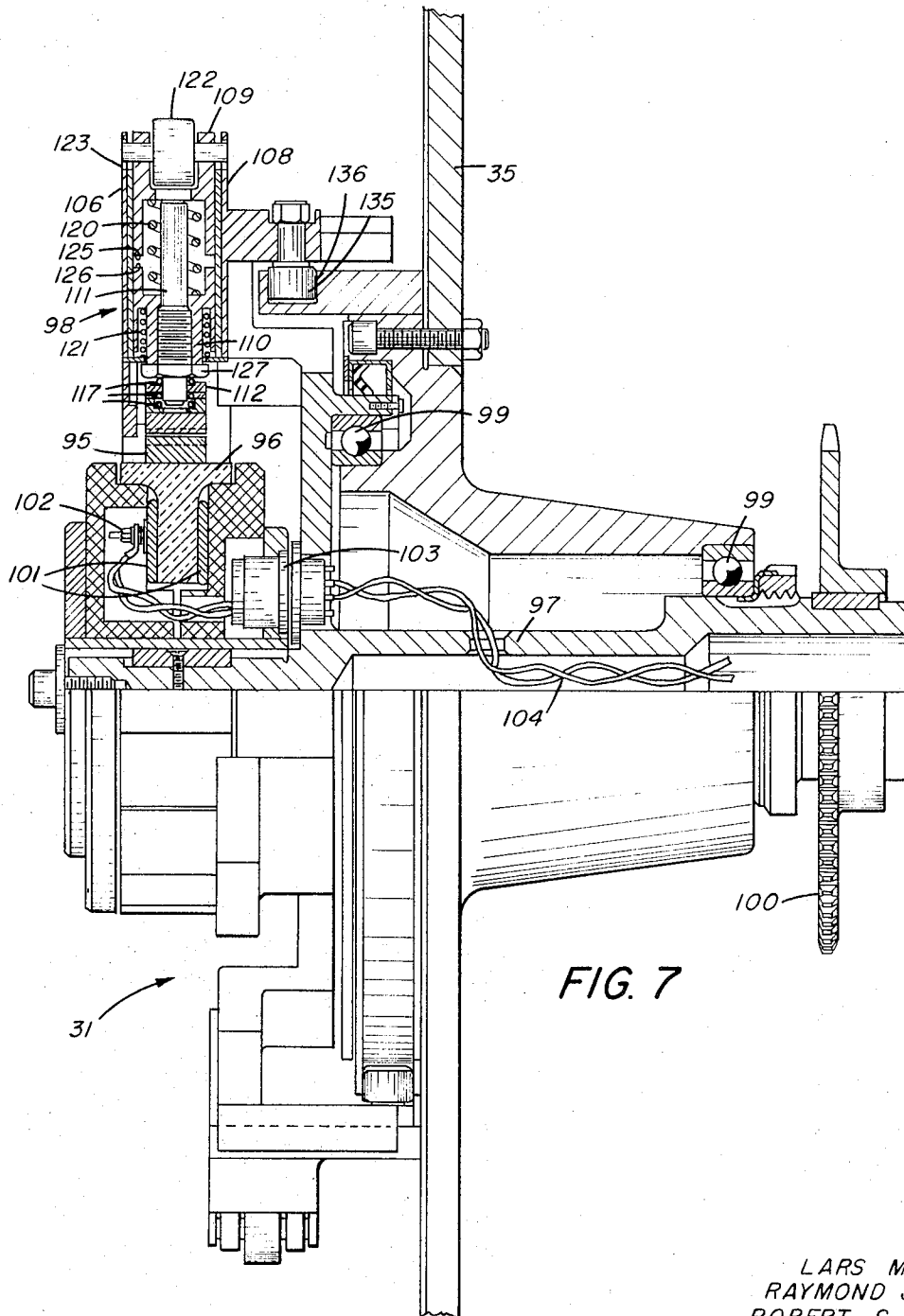


FIG. 7

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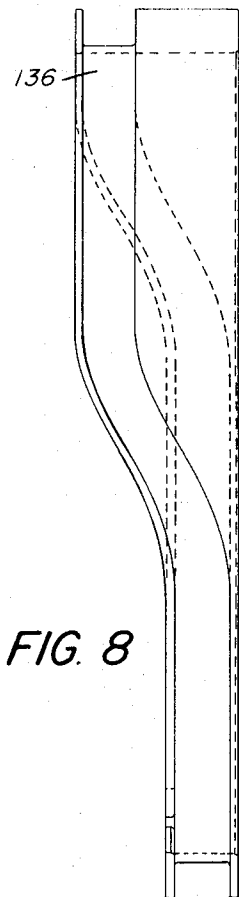


FIG. 8

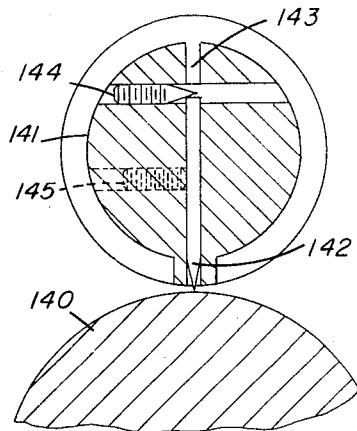


FIG. 10

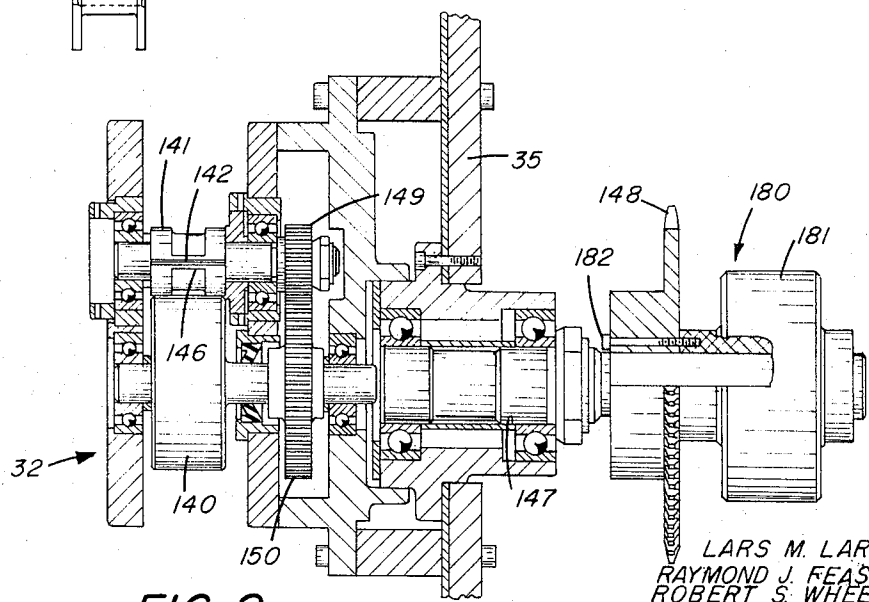


FIG. 9

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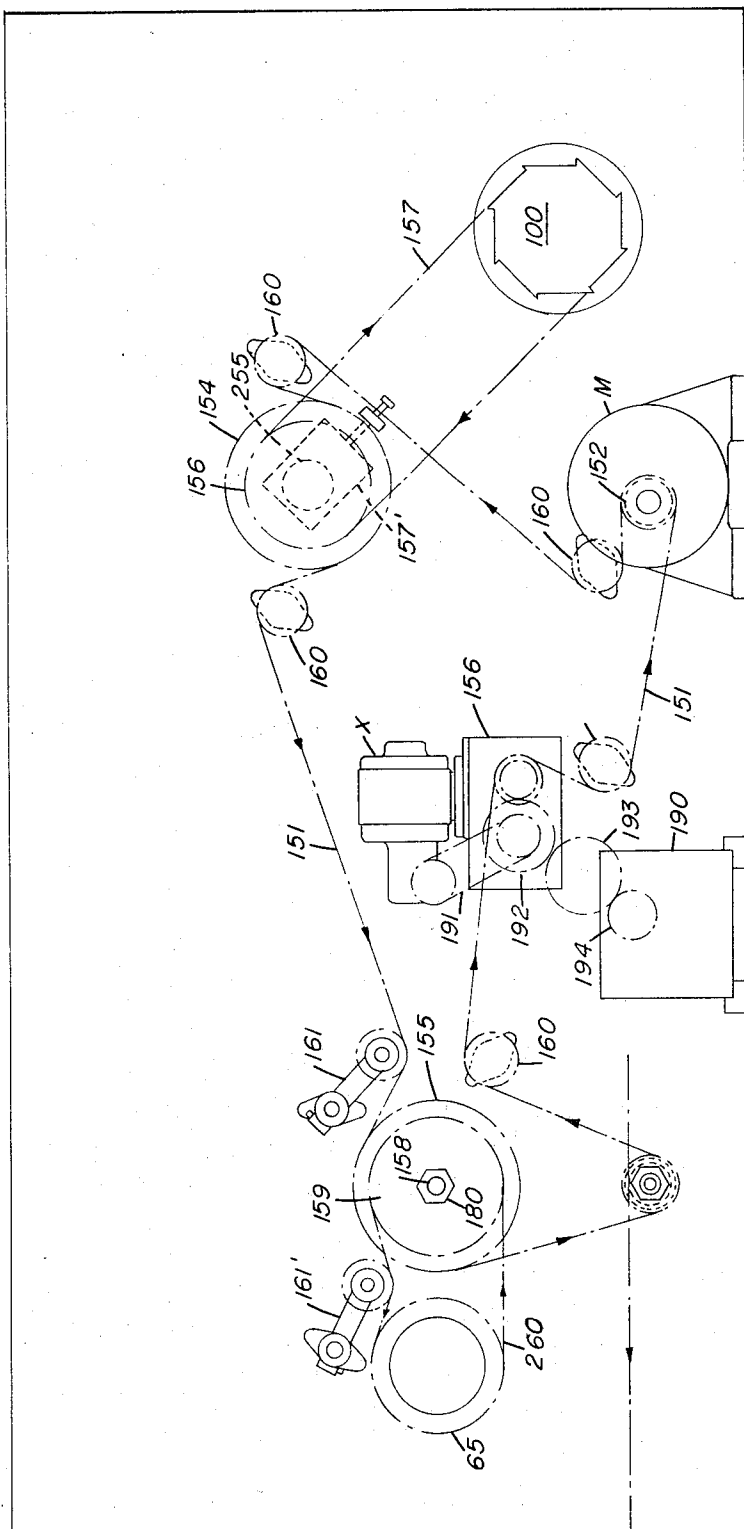


FIG. II

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APPARATUS FOR MAKING AND FILLING LIQUID CONTAINING PODS

This is a continuation-in-part application of Ser. No. 87,757, filed on Nov. 9, 1970 and now abandoned. This invention relates to an apparatus for forming and filling liquid containing pods which have a rupturable seal permitting release of the liquid content when the pod is subjected to a predetermined mechanical stress.

In the well known in-camera processing system an area of light sensitive film after being exposed is processed by first bringing the exposed surface of the film into face-to-face contact with the surface of a liquid confining layer and then spreading between them a thin layer of developer solution. This developer solution which is quite viscous, is contained within a pod associated with the leading end of the film and/or liquid confining layer so that after the film and liquid confining layer have been brought into face-to-face contact and the combination is moved between a pair of pressure members a seal extending along the trailing edge of the pod will be ruptured and the developer solution will be spread in a thin layer between the film and the liquid confining layer.

This liquid containing pod is formed from two layers of laminated material sealed together along four edges. The laminated material consists of an outer layer of relatively strong flexible material, e.g. kraft paper, a middle layer of metal foil to protect the developer solution against the admittance of air, and a thermoplastic inner layer which is inert to the developer solution and keeps the solution from contact with, and contamination by, the metal foil. The thermoplastic coating also serves as the heat-sealing adhesive around the edges of a pod. These pods are generally rectangular in shape and have a length substantially equal to the width of the light sensitive film. The rupturable, or burst, seal of the pod extends along the long edge of the pod facing the light sensitive film and has a length substantially equal to the width of the image area of the film.

The primary object of the present invention is to provide an apparatus for continuously forming and filling such pods at a relatively high rate of speed.

Another object is to provide an apparatus for continuously forming strips of laminated material into a plurality of liquid containing pods, each pod having an elongated liquid containing cavity and a rupturable or burst seal adjacent one long edge thereof adapted to become unsealed throughout its length, or at selected intervals, upon the application of suitable stress to the walls of the pod.

Still another object is to provide an apparatus for making pods as above described wherein the strips of laminated material have a width equal to the width of the pods, the burst and back seals are continuously formed in succession, respectively, by sealing the edges of the strips to form a tubular structure which is then continuously filled with developer solution after which the tubular structure is passed through a cross-sealer to form the end seals of the individual pods. The individual pods are chopped from the strip by cutting between the cross seals.

A further object is to provide a pod making apparatus of the type described wherein the cross-sealer squeezes the liquid from between the strips of laminated material and into adjacent pod cavities before the cross or end seals are made so that each pod will contain a predeter-

mined quantity of fluid and there will be none at the cross-seal area to effect the strength of the end seals of the pod.

And yet another object is to provide an apparatus of the type described wherein a mid-sealer is adapted to overseal selected increments of the burst seal to improve the fluid distribution from the ruptured burst seal, and the cross-sealer includes means for making a partition seal intermediate the ends of the pod cavity at the same time the end seals are made, with the partition seal dividing the pod cavity into two separate cavities for the purpose of improving the distribution of the liquid through the burst seal.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its mode of operation, together with additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIG. 1 is a plan view of one form of pod, with the seals thereof schematically illustrated, which the present invention is designed to fabricate in a continuous manner;

FIG. 1a is a sectional view of the pod, on an enlarged scale, taken substantially on line 1a-1a of FIG. 1;

FIG. 2 is a schematic front elevational view of the present pod making and filling machine;

FIG. 3 is an end view, partly in section, of the burst sealer and/or back sealer;

FIG. 4 is an enlarged front elevational view of the mid-sealer;

FIG. 5 is a sectional view taken substantially on line 5-5 of FIG. 4;

FIG. 6 is an enlarged elevational view of the cross-sealer;

FIG. 7 is a sectional view taken substantially on line 7-7 of FIG. 6;

FIG. 8 is an enlarged end view of the barrel cam of the cross-sealer;

FIG. 9 is an enlarged longitudinal sectional view of the chopper;

FIG. 10 is an enlarged sectional view showing the co-operation between the knife and anvil of the chopper; and

FIG. 11 is a schematic view showing the drive for the mid-sealer, the cross-sealer and the chopper.

The present invention is concerned with the continuous production of expendable, liquid-carrying pods, each pod being adapted to release its liquid content upon the application thereto of a predetermined mechanical stress applied thereto in a direction widthwise of the pod as it is moved between a pair of pressure applying rolls or other members. Referring to FIGS. 1 and 1a, the pod P is rectangular in shape and is formed preferably of two like strips 10 of multi-layer or laminated sheet material having a width equal to the width of the pod. The strips 10, which must be inert to the contained liquid and impervious to air and water vapor, comprise an outer layer 12, a mid-layer 13 and an inner layer 14. The outer or base layer 12 serves as a backing or support and is preferably formed of a thin, tough material which may be plastic but is preferably kraft paper. Middle layer 13 is a thin film or sheet of relatively vapor impervious material such as metal foil. Inner layer 14 is a layer of suitable thermoplastic material

which can be adhered to itself by the application of heat and/or pressure. Inner layer 14 is preferably liquid impervious in order to provide a protective coating for the metal foil 13, thereby preventing the contents of the pod from reaching the foil to corrode or otherwise deteriorate the same or become contaminated thereby. Layers 13 and 14 are relatively thin, being only sufficiently thick to be continuous. The layers comprising one preferred form of laminated strip 10 are a base of kraft paper 12, a layer 13 of silver, steel, aluminum, or lead foil, and a coating 14 of a thermoplastic material such as a thermoplastic resin comprising polyvinyl chloride, a synthetic polymeric resin, polyethylene, etc. The thermoplastic material should preferably be one by the use of which a controlled strength of heat seal can be secured by varying the temperature, pressure and time of sealing at selected parts of the sealed areas for reasons discussed below. To this end, it has been found that a preferably thermoplastic coating may consist of at least one thermoplastic polymer selected from (a) a plurality of mixed polymers and (b) a polymer selected from the group consisting of alcohol soluble cellulose acetate butyrate, a polyhydroxy ether resulting from copolymerization of bisphenol A with epichlorohydrin, and toluene-soluble cellulose acetate butyrate, mixed with a plasticizer selected from the group consisting of triphenyl phosphate and sulfonamide-formaldehyde resin (a sulfonic acid derivative) sold as MHP Santolite by the Montsano Company.

As shown in FIG. 1, the pod comprises a pair of elongated rectangular strips of laminated material sealed together at their edges to form a liquid carrying cavity (s) extending substantially the length of the container. When this pod is combined with a film unit for in-camera processing and is moved through the pressure rolls of members of a camera to process the exposed film, pressure must be exerted downwardly on the top and upwardly on the bottom of the pod and the liquid therein be forced in the direction shown by the arrows 15. This pod is provided with two end seals 16, a back seal 17 and a front or burst seal 18 by the application of heat and/or pressure to the thermoplastic layers 14. The end seals 16 are preferably stronger than the burst seal 18 which is made so that hydraulic pressure induced on the liquid contents of the pod by pressure applied to the outside thereof will burst said seal and allow the fluid to flow from the pod and be spread over the image area of the film as the film unit is moved between the pressure members of the camera. Inasmuch as the hydraulic pressure induced on the fluid in the pod is toward the burst seal 18, it will be appreciated that the back seal 17 need not be stronger than the burst seal but could be weaker than the burst seal without any danger of the seal rupturing before the burst seal and allowing the fluid in the pod to flow in the wrong direction.

Rather than making the pod so that it has a single fluid containing cavity having a burst seal 18 which ruptures the full length thereof, as is common practice, it has been found that a better distribution of the fluid issuing from the pod will be obtained if the burst seal 18 has two mid-seals 19 spaced apart medially of the burst seal and/or the pod cavity is divided into two parts by a partition seal 20 extending from the back edge of the front edge of the pod. The mid-seals 19 are made stronger than the burst seal by the application of more heat or by re-applying heat and pressure to se-

lected increments of the already formed burst seal and/or pressure than is used to make the burst seal. As a result, the fluid issues from the burst seal at spaced points along the front of the pod, namely in areas on either side of the mid-seals as well as between them. If the cavity is divided by a partition seal 20, which is as strong or stronger than the burst seal 18, then the fluid issues from each cavity on opposite sides of the partition seal, through those portions of the burst seal outside of the mid-seals and also from each cavity through that portion of the burst seal intermediate to the mid-seals. To facilitate production of the pods, the opposite ends of the burst seals 18 may overlap the end seals and the opposite ends of the partition seal 20 may overlap the burst and back seals, as shown in FIG. 1, rather than trying to bring these seals into sufficiently close abutment to prevent unwanted leakage at their joints.

Briefly, using the apparatus of the present invention, pods are formed by continuously heat sealing the longitudinal edges of two laminated webs to form a moving tube. This tube is filled with developer and periodically cross-sealed to form individual compartments. Individual pods are obtained by separating the compartments at the cross-seals.

Referring now to FIG. 2, the overall operation of the pod making machine constructed in accordance with a preferred embodiment of the present invention will be described. Two webs or strips of laminated material 10 are drawn from separate stock rolls 22 and 22' into slack boxes 23 from which they are fed into face-to-face contact at point 24 with their thermoplastic layers adjacent one another. From this point they pass through a burst sealer 25 (inboard sealer) which applies heat and pressure to the inboard longitudinal edges of the webs to form the burst seal 18 of the pod P, then to a mid-sealer 26 which forms the mid-seals 19 in the burst seal. Following the mid-sealer the webs, sealed along their inboard longitudinal edges, pass through the back sealer 27 (outboard sealer) which heat seals the other longitudinal edges of the webs to form the webs into a tubular structure. In advance of the back sealer 27 a developer nozzle 28 is inserted between the open edges of the webs and has an elongated end 29 which extends longitudinally of the webs behind the back sealer to a point just beyond the back sealer so that developer solution issuing therefrom will be fed into the webs after they have been formed into a tube. This nozzle 28 is connected with a constant discharge pump, not shown, which continuously feeds developer solution into the tubular structure at a rate commensurate with the speed of movement of the webs so that a predetermined amount of developer will be fed into every given unit length of the tubular structure as it is formed and moves continuously forward. The developer filled tubular structure after being flattened by passing through a pair of rolls 30 is wrapped and continuously paced around a cross-sealer 31 where the end seals 16 of the pods are made. A rotary chopper 32 then chops the tubular structure intermediate of the cross-seals to form the individual pods P which are delivered by the chopper to a conveyor 33 that discharges them to a storage magazine, not shown.

The slack boxes 23 are provided to allow for the splicing of a new web to the end of an expiring stock roll of web material without having to shut down the machine. Since such slack box arrangements are well known in the art for the purpose of splicing a new web

to an expiring web without having to shut down a continuous machine, only one stock roll for each web has been shown as well as a portion of the tortuous path each web might take after leaving its stock roll and before entering the machine. As is well known in the art, these slack boxes will include at least four stock rolls, a spare one for each web 10, and a means for collecting a substantial length of the web leaving each roll before it actually enters the machine. This slack in each web allows the free end leaving an expiring roll to be spliced to the end of the spare roll on a splicing board, not shown, while the machine continues to advance stock therethrough.

The mid-sealer 26 draws the web 10 from the stock rolls and slack boxes and the cross-sealer 31 draws the webs from the mid-sealer and feeds them to the chopper 32 which pulls the webs from the cross-sealer and feeds the individual pods to the conveyor 33. The mid-sealer 26, the cross-sealer 31 and chopper 32 are mechanically linked by a roller chain to insure correct registration. The mid-sealer tends to underdrive and the chopper tends to over-drive the webs with respect to the cross-sealer, thus maintaining a degree of tension in the webs between these sub-assemblies.

Considering that portion of the machine to the right of the slack boxes (looking at FIG. 2) more in detail, all parts of the machine through which the webs travel, including the burst sealer 25, the mid-sealer 26, the cross-sealer 31, the chopper 32, conveyor 33, and all of the guide rolls engaged in passing to and through these sub-assemblies are mounted on a vertical face plate 35 mounted on horizontal supporting frame 36. The several sub-assemblies and guide rolls between them are so mounted on the face plate 35 that the two webs 10 before and after they are joined face-to-face move in a serpentine path all reaches of which are in vertical alignment with one another.

The burst sealer (inboard) 25 and the back sealer (outboard) 27 are essentially identical in construction, except that the burst sealer engages and seals the longitudinal edges of the webs 10 adjacent the face plate 35 whereas the back sealer seals the opposite longitudinal edges of the superposed webs. To this end the sealing jaws of these two sealers are off-set relative to one another transversely of the web path and hence the designations "inboard" and "outboard" are sometimes used to designate the burst sealer and the back sealer, respectively. Because these two sealers are essentially identical, only one of them will be described in detail.

Looking at FIGS. 2 and 3, the burst sealer 25 comprises an upper heater bar 38 and a lower heater bar 39 each having elongated narrow sealing jaws 38' and 39' respectively, which engage opposite sides of the superposed webs to make the inboard heat seal as the webs pass therebetween. Each of these heater bars 38 and 39, which may be in the order of 6 inches long, has an elongated electrical heating element 40 embedded within a bore therein which is suitably connected to a source of electrical power, not shown. A thermocouple may be embedded in a bore 43 of each of the heater bars to control the current passing to the electrical heaters in a well known manner for the purpose of maintaining the bars at the proper sealing temperature.

The lower heating bar 39 is mounted on a support plate 44 which is in turn mounted on four rubber shock absorbers 45 fixed to the horizontal arm of a right angle bracket 46 mounted on a vertical face plate 35. The

lower heater bar is separated from the support plate 44 by a strip of insulation 47 to reduce the conduction of heat from the heater bar 39 to the supporting structure therefor. The upper heater bar 38 is connected to holder 48 by bolts 49 and insulated therefrom by a strip of insulation 50. Opposite ends of the holder 48 are pivotally connected to hinge pintle 51 carried by the vertical back plate 52 so that the upper heater bar 38 may be raised from the lower heater bar to permit threading of the superposed webs 10 therebetween. The upper heater bar 38 is moved between its raised and lowered positions relative to the lower heater bar 39 by an air cylinder, not shown, the piston 53 of which has a link 54 connected thereto having a hooked end 55 embracing a pin 56 connected to the top of the holder 48. Pressure between the sealing jaws 38' and 39' of the two heater bars 38 and 39, respectively, is induced by a tension spring 57 connected at its upper end to a pin 58 on the holder 48 and at its lower end to an eye member 59 connected to an adjusting bolt 60 mounted on the horizontal arm of bracket 46. It will be observed that the lower end of spring 57 is substantially in vertical alignment with the hinge pintle 51 of the upper holder while the upper end of the spring is connected to the holder 48 to one side of the hinge pintle 51. As the result of this, the spring will act to provide the pressure between the jaws of the heater bars when upper bar 38 is moved to its lowered position, and when the upper bar is pivoted to its raised position the centerline of this spring will pass to the other side of the hinge pintle and act to hold the upper bar in a raised position. It is pointed out that the connection between the link 54 of air cylinder and pin 56 on the holder 48 is such that the air cylinder does not force the upper heater bar down against the lower heater bar when they are in a sealing relation. Except for the weight of the upper heater bar 38 and its holder, the pressure between the sealing jaws 38' and 39' of the two heater bars is controlled by the tension in spring(s) 57 and which tension can be adjusted by means of adjustable bolt(s) 60. The pressure required between the sealer jaws 38' and 39' to make the burst seal of the pod will vary with the temperature of the jaws, the speed at which the webs are moving therebetween and the thermoplastic layer used as the heat sealing layer on the webs. With webs using the preferred thermoplastic polymer mentioned above as the heat seal layer, and traveling through the burst sealer having jaws approximately 6 inches long and 1/16 inch wide at a speed of 50 feet per minute and with both jaws heated to approximately 310°F, a satisfactory burst seal can be produced.

When operating at the pressures and speeds set forth above it has been found that the webs can be moved between the sealer jaws without difficulty, particularly if their faces have a thin coating of a low friction material thereon, e.g. Teflon. However, if it is desired to increase the speed of the webs appreciably, in order to make a satisfactory burst seal it would be necessary to increase the temperature and/or pressure between the sealing jaws because the sealing time would be shortened. Under these conditions the frictional drag between the webs and the sealing jaws might become prohibitive. Also, higher temperatures reduce the webs' strength and additional clamping forces necessary were found to cause fracturing of the web. To overcome this problem and adapt the machine for higher speed production, an electric sonic vibrator 62 is shown mounted

on the holder 48 of the upper heating bar 38. The sonic vibration of the upper heating jaw relative to the lower heating jaw was found to reduce the friction drag and also to provide more efficient sealing operation. The rubber shock absorbers 45 isolate the vibration from the main frame of the machine.

The back or outboard sealer 27 is essentially the same as the burst or inboard sealer 25 described above, the only difference being that the heater bars are reversed in their holders so that the sealer jaws 38' and 39' of an outboard sealer will engage and seal the other longitudinal edges of the superposed webs 10. While the back seal of the pod P can be made weaker, equal to or stronger than the burst seal, it is preferred that it be at least equal in strength or slightly stronger than the burst seal. Accordingly, the temperature of the sealing jaws of the back sealer should be approximately 310°-320°F assuming that these jaws have the same clamping force as the burst sealer jaws.

Coming now to the mid-sealer, the superposed webs 10 leaving the burst sealer 25 are wrapped (180°) around a flanged drum that carries eight equally spaced heaters. Spring loaded back-up rollers iron the burst seal of the webs when the heaters pass under them. Referring to FIGS. 4 and 5, the flanged drum comprises a hollow octagonal hub member 62 having a flange which is bolted to the flange of a hollow shaft 63 and rotatably mounted in a bearing 64 extending through the vertical face plate 35 and driven by a sprocket 65. Pressed, or otherwise fastened on the free end of the hub member 62 is a cup member 66 the periphery of which is provided with a flange 67 against which the outboard edges of the superposed webs 10 are held when the remainder of the width of the webs, except the burst seal formed at the inboard edge, rest on the periphery thereof. This cup member 66 is formed of a heat insulating material, e.g. phenolic, so that the body of the webs will not be heated while passing over the mid-sealer. Fixed to the eight faces of the hub member 62, and spaced inwardly thereof from the cup member 66, are eight blocks of heat insulating material 68 on the outer face of each of which is mounted on a metal heater 69. The outer face 70 of each heater 69 is arcuate and provided with a notch 71 to make the interrupted mid-seal 19 in the burst seal 18 in the pod as shown in FIG. 1. The arcuate face 70 of the heaters are flush with, or extend slightly above, the periphery of the cup member 66 so that the sealed edge of the webs 10 coming from the burst sealer 25 engage the outboard edge thereof.

Each heater 69 is heated by an electric heating element 73 embedded therein. The temperature of each heater is maintained by a temperature-sensor 74 embedded therein. Electrical power for the heaters is obtained from a power cable 75 extending through the hollow drive shaft 63 and connected to the heater leads by a commutator arrangement of suitable well known construction, not shown. The flanged cup member and heaters pull the webs 10 from their stock rolls or slack boxes and through the burst sealer 25 and as they advance the superposed webs to the back sealer 27 a succession of four spring loaded rollers 77 iron the burst seal on the heaters 69 as it passes under them. The four rollers 77 are mounted on an arcuate support member 78 fixed to the vertical face plate 35 by bolts 79 and in spaced relation relative to said face plate by spacer sleeves, not shown. Each roller is rotatably mounted on

the end of lever 80 pivotably mounted at 81 to the arcuate support member and is urged toward the heaters by a plunger 82 loaded by a spring, not shown, within a hollow member 83 threadably engaging a bracket 84 carried by the arcuate support. As will be apparent from FIG. 5, the rollers 77 have a narrow edge 77' approximately as wide as the burst seal, e.g. 1/16 inch, which engages the burst seal 25 of the webs and presses it against the heaters 69 as the webs and heaters pass under them. The pressure applied to the burst seals by rollers 77 can be adjusted by an adjustment of the spring plunger screw 83, and to limit the movement of the pivotal rollers 77 when no heater is below them there is provided an adjustable stop screw 85 which engages the opposite ends of the lever 80. It has been found that satisfactory mid-seals can be made in the burst seals if the heater bars are heated to 250° F and the rollers apply a localized pressure of approximately 6 pounds.

Just ahead of the outboard or back sealer 27 the nozzle 28 is inserted into the unsealed edges of the webs and has a flattened elongated end which extends longitudinally between the webs behind the back sealer in the direction of movement of the webs to a point beyond the back sealer 27. The developer solution is fed into this nozzle by a well known type of constant discharge pump, not shown, and at a rate commensurate with the speed at which the webs are being fed so that a predetermined amount of developer fluid will be fed into the tubular web structure per unit length thereof. Since the outboard edges of the webs will be sealed at the back sealer 27 ahead of the discharge end 29 of the nozzle, a continuous tubular web structure will be formed which will be filled with developer solution issuing from the nozzle.

As mentioned above, the back sealer 27 is substantially identical with the burst sealer 25 above described, and the same pressure and temperature conditions can be used in making the back seal as are used in making the burst seal. It might be mentioned here that for accurately guiding the webs into and through both the burst and back sealers, a pair of guide rolls 90 is mounted on the vertical face plate 35 ahead of and beyond each of these sealers. As shown in FIG. 2, these guide rollers are mounted so that their axes are vertical and they are spaced apart by a distance substantially equal to the width of the webs. They are provided with circumferential grooves into which the edges of the web extend to be edge guided in such a way as to locate the web vertically as well as horizontally relative to the jaws of the sealers.

The liquid filled tubular web structure W leaving the back sealer passes between the two rollers 30 which flatten it to some extent. It then passes around the cross-sealer 31 which serves to pull the webs from the mid-sealer and at the same time make the end seals 16 and/or the partition seal 20 of the pods P.

Referring now to FIGS. 6 and 7, the cross-sealer comprises eight heated sealing jaws 95 equally spaced circumferentially of a heated ring 96 to be heated thereby. This ring is fixed to a hollow spindle 97 that also carries eight ironing heads 98 equally spaced circumferentially of the ring but in offset relation to the sealing jaws 95 so that an ironing head is located intermediate each pair of jaws. The hollow spindle 97 is rotatably mounted in the vertical face plate 35 by bearings 99 and is driven by a sprocket 100 fixed to the end

thereof. The ring 96 is adapted to be heated by circular electrical heaters 101 embracing the same, see FIG. 7, power being fed to said heaters through circuits including terminals 102 on the ring, a plunger and socket connector 103 mounted on the periphery of the spindle and feed wires 104 passing through the hollow spindle and out through a hole therein to connector 103.

As best shown in FIG. 6, each sealing jaw 95 has two flat sealing surfaces 95' which meet at an obtuse angle such that the right-hand sealing face of one jaw and the left-hand sealing face of the adjacent sealing jaw lie substantially in a common plane. The length of the sealing faces of the jaws are substantially equal to the width of the liquid filled web and make the end seals 16 of the pod P. The jaws 95 are in line with the back sealer so that the liquid-filled tube W formed by the edge sealed composite web can be fed directly onto the wrapped (180°) around the heater jaws and thus follows an octagonal path. Looking at FIG. 6, it will be seen that the reach of liquid-filled web extending between the ridges of adjacent heater jaws 95 is straight and taut and is equal to the length of one pod P so that the end seals 16 of each pod are made simultaneously. This insures that each pod will contain a predetermined amount of developer liquid therein because, as will be most apparent from FIG. 6, as the liquid-filled tube approaches the cross-sealer and the heater jaws move up against it from the bottom, the tubular web will be engaged by a flat face, then the ridge and finally the second flat face of a given jaw in succession and such engagement will cause the liquid in the tubular web to be squeezed from that portion of the tube engaging the jaw and forwardly or rearly into one of the sections of the tube adjacent to jaws.

For making the partition seal 20 the heater ring 96 also carries eight sealing jaws 105, one located intermediate each pair of sealing jaws 95. The actual sealing surface of these jaws is quite narrow and have their top surface substantially flush with the adjacent sealing faces of the jaws 95 they are located between so that the partition seals 20 for each pod P is made simultaneously with the end seals 16 thereof.

Since each of the ironing heads 98 is exactly the same, both structurally and functionally, only one of them will be described in detail. Each ironing head 98 comprises a rectangular housing 106 slidably mounted in horizontal ways 134 fixed to the spindle to move axially of the spindle. Within this housing 106 there is mounted a plunger assembly consisting of a stationary tube 108 within which is slidably mounted a first, upper sleeve 109 and a second, lower sleeve 110. A shaft 111 is threaded into the lower sleeve 110 and has attached to the lower end thereof an elongated jaw block 112 at the opposite ends of which there are fixed ironing jaws 113 which move into pressing engagement with that portion of the liquid-filled tubular web wrapped on adjacent sealing surfaces of two successive heater jaws 95 to make the two end seals of one pod at the same time. While the jaw block 112 may be made of metal, the ironing jaws 113 thereon are preferably made of an insulating material to eliminate the conduction of heat away from the heater jaws when the two are in sealing engagement relative to the tubular web. Fixed to the bottom of the jaw block 112, and within a recess therein, is a back-up plate 114 to which the ironing jaw 115 for making the partition seal is connected. The ironing jaw 115 has a narrow rib 116 protruding there-

from which cooperates with the partition sealing jaw 105 to make the partition seal 20 of a given pod at the same time the end seals thereof are made. Rubber O-rings 117 separate the jaw block 112 and back-up plate 114 from the shaft 111 and each other to cushion the engagement of these parts as the ironing jaws are moved down into engagement with their respective heater jaws.

Referring particularly to FIG. 7, the upper sleeve 109 is moved upwardly relative to the lower sleeve 110 by a compression spring 120 and the lower sleeve 110 is moved upwardly relative to the stationary housing 108 by a second compression spring 121 which is much weaker than compression spring 120. Accordingly, the ironing jaws 113 and 115 are normally raised from pressing relation with their associated heater jaws. They are lowered to pressing relation to their associated heater jaws when a downward pressure is applied to a roller 122 whose axle is journaled at the upper end of the upper sleeve 109 and passes through elongated slots 123 in the rectangular housing 106 and the stationary tube 108 of the plunger assembly. Downward pressure on the roller 122 forces the upper sleeve 109 downwardly against its compression spring 120 which, being a very strong spring, does not compress but forces the lower sleeve 110 downward against the compression spring 120. Further depression of the upper sleeve 109 then pushes the lower sleeve 110 downwardly and along with it the shaft 111 threaded thereto and moves the ironing jaws 113 and 115 downward until they are in pressing engagement with their respective heater jaws 95 and 105, respectively. Further downward travel of the upper sleeve 109 compresses the spring 120 creating the pressure required to make the end seals and the partition seal of a given pod P. The extent of movement of the ironing heads relative to their respective heater jaws to accommodate the thickness of the liquid-filled tubular web and to produce the desired sealing pressure on the seal can be accommodated by adjusting the threaded shaft 111 in the lower sleeve and locking it in position by lock nut 127.

Movement of the ironing heads 113 and 115 to and from their sealing position is controlled by an arcuate internal cam 130 mounted on the vertical face plate 35 by bolts 131 and spaced from the plate by spacers, not shown, to lie in the path of the rollers 122 as the cross-sealer rotates. As clearly shown in FIG. 6, the arcuate internal cam is so oriented relative to the cross-sealer that it is engaged by the roller 122 of a given ironing head after the liquid-filled web W has been wrapped over the heater jaws 95 thereof and it is of such length that it holds said ironing heads in sealing condition during rotation of the cross-sealer up to the point where the web leaves the cross-sealer. In other words, as shown in FIG. 6, the internal cam 130 holds three successive ironing heads 98 in sealing position at each revolution of the cross-sealer, whereas the other five ironing heads are allowed to resume their normal open position in which the web is allowed to leave and/or enter the cross-sealer at points spaced apart approximately 180°. In order that the liquid-filled web W can be fed onto and from the sealing jaws of the cross-sealer the ironing heads 98 must be moved from above their corresponding sealing jaws at the points where the web enters and leaves the cross-sealer. To this end, the ironing heads 98 are slidably mounted on the spindle to move axially thereof between an operative position, wherein

they are radially above their corresponding sealing jaws 95, and an inoperative position, wherein they are moved toward the vertical face plate 35 and out of radial alignment with their corresponding heating jaws. The ironing heads are slidably mounted on the spindle by a slide member 133 thereon, the beveled edges of which are confined by ways 134. The ironing heads are reciprocated axially of the cross-sealer between their operative and inoperative positions by the engagement between a roller 135 fixed on an arm extending from the housing 106 and stationary barrel cam 136 fixed to the vertical face plate 35. This barrel cam 136 encircles the cross-sealer and, as clearly shown in FIG. 8, has a contour such that it will quickly shift the ironing heads between their operative and inoperative positions and hold them in either position for a certain part of one rotation of the cross-sealer. This barrel cam is so oriented with respect to the internal cam 130 that the ironing heads 98 are moved to their operative position after the web W is fed onto the cross-sealer and before the rollers 122 thereon engage the internal cam 130. They are held in this position until just before they leave the point where the web leaves the cross-sealer, at which time they are moved to their inoperative position and remain in such position until they again approach the internal cam 130. Inasmuch as a strong heat seal is desired at the ends of the pod, it may be desirable to crimp the same, as shown in FIG. 1a. To this end, the web engaging faces of the sealing jaws 95' can be made in the form of saw teeth, or if flat surfaces are used on the jaws 95' a high temperature might be used on the heaters to obtain a strong end seal. Using the crimped type of seal, it has been found that a heating jaw temperature of 325°-400° F produces a satisfactory end seal on the pods.

As the liquid-filled web W leaves the cross-sealer 31 it is pulled into and fed through the chopper 32, which is of the rotary dinking type, wherein the individual pods are chopped from the web by cutting through the middle of the cross-seals. This chopper, which serves to pull the web from the cross-sealer and to feed the individual pods onto the conveyor 32, comprises a driven cylindrical metal anvil 140 and drive roll 141 which is made of rubber, or some other resilient material providing a driving surface having a high coefficient of friction, e.g. polyurethane, or being metal and having rubber tires thereon. The composite liquid-filled web is fed between the anvil 140 and the drive roll 141 and the periphery of the drive roll is recessed so that only the longitudinal sealed edges of the web will be engaged and the liquid-filled pod portion thereof will not be compressed enough to burst any of the edge seals. A knife blade 142 is slidably mounted in a slot 143 extending diametrically through the drive roller, and its penetration from the periphery of the roller can be adjusted by means of tapered screws 144 engaging the innermost end thereof. It is locked in adjusted position by set screws 145. The drive roller 141 has a circumferential length equal to the length of the individual pods so that for each revolution thereof the web will be fed one pod length. As will be more fully explained below, the drive for the machine is adjusted so that the chopper blade 142 will cut the web at the middle of successive cross-seals, or to be more exact, at the point in the cross-seals engaged by the ridge of each heater jaw 95 of the cross-sealer. It will be noticed that a portion 146 of the periphery of the drive roller is not recessed to fa-

cilitate manufacture and because it is needed to support the knife blade 142. However, this portion 146 is no wider than the cross-seals between pods and engages the web at said cross-seals as the knife is chopping a pod from the web so that it will not engage and compress the filled portion of the pods.

The anvil 140 is somewhat larger in diameter than the drive roller and is driven from a drive shaft 147 extending through and journaled in the vertical face plate 35 and which shaft is in turn driven by a sprocket 148 at the rear of the vertical face plate. The drive roller is driven by a gear 149 engaging a gear 150 on the anvil shaft, the ratio between these gears being such that the drive roller rotates faster than the anvil and makes one revolution when feeding the web one pod length. Should it be found that the pull required of the chopper to advance the web from the cross-sealer to the chopper is so great as to cause slippage between the drive roller and the chopper, and hence cause misregistration of the chopper blade with the cross-seals, then a separate web drive may be added ahead of the chopper. Such a separate drive could consist of a drive roller and anvil combination like that disclosed located immediately ahead of the chopper, but in which the drive roller carries no knife blade. This added drive roller and anvil assembly could then be directly geared to the drive roller and anvil of the chopper so that they would feed web W at the same rate.

As shown in FIG. 11, the mid-sealer 26, the cross-sealer 31, and the chopper 32 are mechanically linked by a roller chain designated at 151 to insure correct registration of the web and these components. A single drive motor M serves as a prime mover for each of these three assemblies and has a drive sprocket 152 engaged by the roller chain 151. Moving in the direction of drive from the motor sprocket, as indicated by the arrows, the chain 151 passes to and around a drive sprocket 154 rotatably mounted on the rear of the vertical face plate 35, thence around another drive sprocket 155, to and around the drive sprocket 148 for chopper 32, and finally through a drive for the constant discharge pump, designated generally at 156, and back to the motor sprocket. The chain 151 is guided in its travel by a plurality of idler sprockets 160 and a chain tensioner 161.

The drive for the cross-seal sprocket 100 is derived from the drive sprocket 154 on the shaft 255 of which a smaller sprocket 156 is fixed and which in turn drives the cross-sealer sprocket 100 through a roller chain 157. Chain 157 may be tensioned by a conventional chain tensioner designated 157'. The drive for the mid-sealer sprocket 65 is derived from drive sprocket 155 on the shaft 158 of which smaller sprocket 159 is fixed and which in turn drives the mid-sealer sprocket 65 through a roller chain 260. The chain 260 is tightened by a chain tightener 161'. As mentioned above, the drive for the mid-sealer, cross-sealer and chopper is so designed that the mid-sealer tends to under-drive and the chopper tends to over-drive the webs W with respect to the cross-sealer in order to maintain a degree of tension on the webs between these sub-assemblies. In order to be able to adjust the mid-sealer and chopper relative to the other sub-assemblies so that the mid-seals are placed in the proper position in the burst seal and the chopper cuts the pods in the middle of the cross-seals, the drive sprockets for each of these members is provided with a commercial infinite indexer

180. As shown in FIG. 9 in connection with the chopper, such infinite indexer comprises a knob 181 indexably connected to the end of the drive shaft 147 of the chopper and to which the drive sprocket 148 rotatably mounted on the shaft is fixed by one or more bolts 182 to be indexed relative to the drive shaft.

Since the web path through the cross-sealer 31 is octagonal, if the cross-sealer were rotated at a constant angular velocity the liquid-filled web would be pulled at a variable linear velocity (reaching a minimum when the effective pulling radius equals the distance from the center of the flats of the octagon). If the cross-sealer could itself be driven from a constant angular velocity to the octagon driving the web, the web would be pulled at a constant lineal velocity. To accomplish this a separate octagonal sprocket 100 was designed for the cross-sealer, see FIG. 11, and it is fixed to the drive spindle with the octagonal chain path defined thereby aligned with the octagonal web path on the cross-sealer. It will be obvious that the cross-sealer need not have eight sealing heads, but could have four, five, six, or any suitable number depending upon the size of the cross-sealer and the speed of production required. Accordingly, depending upon the number of sealing heads used, the path of the web around the cross-sealer could be a polygon of various shapes. It follows then that as the polygonal shape of the web path through the cross-sealer changes, depending upon the number of sealing heads used, the polygonal shape of the drive sprocket for the same must be changed correspondingly in order to have the webs moved at a constant linear velocity thereby.

Referring again to FIG. 11, the constant discharge pump for the developer solution is designated as box 190. This pump is driven by the drive chain 151 through the gear train including gears 192, 193 and 194 at a rate commensurate to the rate at which the webs are being fed through the apparatus so that each pod will contain a given amount of fluid regardless of the speed at which the machine is operated. The connection between the drive chain 151 and the pump drive includes a disengageable clutch, not shown, which allows the pump to be driven independently of the web driving part of the apparatus, by motor X through timing belt 191, for the purpose of purging and/or cleaning the pump and/or the nozzle 28 and lines fed thereby.

Referring to FIG. 1, since conveyor 33 which receives the individual pods P from the chopper and discharges them into a suitable magazine, not shown, may take any form its construction has not been shown in detail. Preferably, it comprises a pair of stationary vertical plates spaced apart by a distance slightly greater than the width of the pods so as to guide the pods during lengthwise movement thereof. The pods may be moved between these guide plates by a motor driven endless belt on the surface of which they may be confined by a second endless belt spaced above the lower belt by a distance such as not to apply any undue downward pressure on the pods.

While the apparatus has been illustrated and described in a form necessary to fabricate a certain type of pod, it will be appreciated that it might be modified depending upon the pod construction without going beyond the spirit of the present invention. For instance, if the pod construction should be such that a single cavity is desired rather than the double cavity construction shown, then the partition seal 20 would not be re-

quired. In this case, the partition sealing jaws 105 and their associated ironing jaw 115 could be removed from the cross-sealer 31. By the same token, if a single mid-seal is desired in the center of the burst seal of the pod instead of the two spaced mid-seals 19, as shown in FIG. 1, it would only be necessary to remove the notch 71 from the arcuate face 70 of the heaters 60 of the mid-sealer 26, see FIG. 3. Also, in order to reduce the heat necessary to make the end seals 16 and/or the mid-seals 18 of the pod it may be desirable to heat the ironing jaws 113 of the cross-sealer 31 and the spring loaded rollers 77 of the mid-sealer, respectively, as well as the sealing jaws with which they cooperate to make these seals.

This invention has been described with reference to particular embodiments thereof but it will be understood that variations and modifications may be effected within the spirit and scope of the invention.

We claim:

1. In an apparatus for continuously forming a plurality of liquid-filled pods each having a sealed passage adapted to become unsealed upon the application of a predetermined physical stress, the combination of two supplies of multilayer strip material having a heat sealable coating on one surface; means for guiding said two strips of material from their respective supplies into superposed relation with the surfaces having the heat sealable coating facing one another after which they are continuously advanced through a given path conjointly in said superposed relation; a first heat sealer engaging one longitudinal margin of said superposed strips as they are advanced along said path to activate said heat sealable coatings and rupturably seal the strips together along said margin; a mid-sealer spaced along said path from said first heat sealer and engaging said one sealed margin at regularly spaced intervals to increase the strength of said seal at said intervals relative to the strength of the rupturable seal made by said first heat sealer; a second heat sealer engaging the other longitudinal margin of said strips as they are advanced along said path to activate said heat sealable coatings and seal the strips together along said other margin and thus form the strips into a tubular structure; an elongated filler tube extending into the open margin of said strips ahead of said second heat sealer and longitudinally along said strips to an extent that its exit end extends beyond said second heat sealer to deposit a liquid into said tubular structure; means for pumping liquid into said filler tube at a rate commensurate with the rate of movement of said strips along said path; a rotary cross-sealer including a plurality of pairs of opposed heating and pressure applying members movable into engagement with said liquid-filled tubular structure at regularly spaced transverse sections thereof as the structure is advanced, said members being adapted to transversely bond the heat sealable coatings of said strips together at spaced transverse sections to form a succession of connected liquid-filled compartments; and chopping means for severing said compartments from one another at said transverse bonded sections to form a plurality of individual liquid-filled pods.

2. An apparatus for continuously forming liquid-filled pods as defined in claim 1, wherein the mid-sealer, the cross-sealer and the chopper in combination constitute the means for pulling the strips from the supply and continuously feeding them at a given rate through said path.

3. An apparatus for continuously forming liquid-filled pods as defined in claim 2, characterized by the fact that the mid-sealer, the cross-sealer and the chopper are mechanically linked to ensure correct registration of the operations performed on the strips by these parts.

4. An apparatus for continuously forming liquid-filled pods as defined in claim 3, characterized by the fact that the mid-sealer tends to under-drive and the chopping means tends to over-drive the strips with respect to the cross-sealer to maintain a degree of tension in the strips between these parts.

5. An apparatus for continuously forming liquid-filled pods as defined in claim 1 wherein said first and second heat sealers each comprise a pair of parallel heated jaws between which the margins of the superposed strips are moved, one or the other of each pair of jaws being sonically vibrated toward and from its companion jaw to reduce the friction drag on the strips being moved between said jaws.

6. An apparatus for continuously forming liquid-filled pods as defined in claim 1, wherein said mid-sealer comprises a driven flanged drum; a plurality of heated jaws carried by and equally spaced circumferentially of said drum, each jaw having an arcuate surface forming a part of a circle concentric with the flange of the drum and which frictionally engage and support the innermost of the superposed strips at spaced intervals when said strips are wrapped therearound; and a plurality of spring-loaded back-up rollers circumferentially spaced around said drum for ironing the margin of said strips sealed at said first heat sealer when the jaws pass under them and increase the adhesive strength of the seal at selected points along the length of said margin.

7. An apparatus for continuously forming liquid-filled pods as defined in claim 1, wherein said rotary cross-sealer comprises a rotatable shaft whose axis extends transversely of, and whose periphery underlies, a portion of the path of said strips; a plurality of heated jaws fixed to and equally spaced circumferentially of the periphery of said shaft and adapted to move into engagement with and advance the liquid-filled tubular structure which is wrapped around the cross-sealer; an ironing head for each jaw; means for mounting said ironing heads so that they rotate with said jaws and are capable of movement to and from an operative position, wherein each ironing head presses the tubular structure against an associated jaw to make a cross-seal in the tubular structure; and means for moving each ironing head to its operative position after said tubular structure has engaged its associated jaw, and holding it in said operative position during a partial rotation of said cross-sealer after which said ironing head is moved from its operative position to allow the cross-sealed tubular structure to leave said cross-sealer.

8. An apparatus for continuously forming liquid-filled pods as defined in claim 7, wherein each of said jaws has two sealing surfaces arranged in the form of an inverted V with its vertex extending transversely of the path of said tubular structure, said jaws spaced apart by a distance such that the adjacent sealing surfaces of

successive jaws form the end seals of a given pod, and wherein each ironing head is positioned intermediate each adjoining pair of jaws and includes two heads adapted to mate with adjacent sealing surfaces of successive ones of said jaws and simultaneously produce the end seals of one pod when moved to its operative position.

9. An apparatus for continuously forming liquid-filled pods as defined in claim 7 wherein said ironing heads are normally moved from said operative position by spring means, and wherein the means for moving said ironing heads to their operative position includes a stationary cam embracing a portion of the periphery of said cross-sealer, and a cam follower associated with each ironing head adapted to engage said cam and be moved by engagement therewith to move said ironing heads to their operative position and hold them in said position during a portion of one rotation of its cross-sealer.

10. An apparatus as defined in claim 9, characterized in that the connection between said cam followers and their associated ironing heads comprises at least one compressible member which is put under compression by movement of said cam followers when moved by said cam so that the pressure applied to the jaws by said ironing heads to make said cross seals is resilient rather than positive in nature.

11. An apparatus as defined in claim 7, including means for mounting said ironing heads for movement axially of said cross-sealer between a retracted position, wherein they are displaced from their respective jaws to allow the tubular structure to engage the disengage said jaws as it enters and leaves, respectively, said cross-sealer; and an extended position, wherein they are in radial alignment with their associated jaws; and including means for moving each of said ironing heads to its extended position after the tubular structure is wrapped onto their respective jaws and holding it in said extended position until the tubular structure is about to leave the cross-sealer at which time it is moved to its retracted position and held therein until it is again moved to its extended position.

12. An apparatus as defined in claim 11, wherein said last mentioned means includes a stationary barrel cam concentric with, and located axially to one side of, the path of said jaws and engaged by a cam follower connected to each of said ironing heads.

13. An apparatus as defined in claim 7 including means on the cross-sealer for making a partition seal in each pod intermediate said cross-seals to divide the pods into two separate compartments, said means including a heated partition jaw fixed to said shaft between each pair of said jaws, said heated partition jaw extending transversely of said tubular structure wrapped around said cross-sealer and having a sealing surface adapted to engage the under side of that portion of the tubular structure stretched between two successive jaws; and a partition ironing head fixed to each of said first mentioned ironing heads arranged to squeeze the liquid-filled tubular structure down against said partition jaw and heat seal the inner surfaces of the structure together at the same time the cross-seals are made.

14. An apparatus as defined in claim 7, wherein that portion of the tubular structure wrapped around and advanced by said cross-sealer follows a path which is a portion of a polygon having a number of sides corre-

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sponding to the number of jaws; and means for rotating said cross-sealer so that the tubular structure will be advanced thereby at a substantially constant linear velocity.

15. An apparatus as defined in claim 14, wherein said last mentioned means includes a drive shaft on said cross-sealer, a polygonal sprocket fixed to said drive shaft and having a polygonal path aligned with the path of the tubular structure passing around said cross-sealer, and a constant angular velocity power source for driving said sprocket.

16. An apparatus as defined in claim 7, in which there are eight pairs of jaws so that the path of the tubular structure through the cross-sealer is a portion of an octagon, and including means for rotating said cross-sealer so that the tubular structure will be advanced thereby at a constant linear velocity; said last mentioned means comprising a drive shaft for said cross-sealer; an octagonal sprocket fixed to said shaft with its octagonal path aligned with the octagonal portion of the path of the tubular structure; and a drive chain driven from a constant angular velocity source engaging said octagonal sprocket.

17. An apparatus as defined in claim 15, including a common drive for said mid-sealer, cross-sealer and chopper for advancing said superposed webs at a constant linear velocity between these three components, said common drive comprising a circular sprocket for each of the mid-sealer and the chopper; a drive motor; and a chain drive inter-connecting said circular sprockets and the polygonal sprocket of the cross-sealer and driven by said drive motor.

18. In an apparatus for continuously forming a plurality of liquid-filled pods each having a sealed passage adapted to become unsealed upon the application of a predetermined physical stress to the exterior of the pods, the combination of:

1. two supplies of strip material having a heat sealable coating on one surface;
2. means for pulling said two strips of material from their respective supplies and guiding them into su-

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perposed relation with the surfaces having the heat sealable coating facing one another and continuously advancing said strips through a given path conjointly in said superposed relation;

3. a first heat sealer engaging one longitudinal margin of said superposed strips as they are advanced along said path to activate said heat sealable coatings and rupturably seal the strips together along said margin;
4. a second heat sealer spaced along said path from said first heat sealer and engaging the other longitudinal margin of said strips as they are advanced along said path to activate said heat sealable coatings and seal the strips along said other margin and thus form the strips into a tubular structure;
5. an elongated filler tube extending into the open margin of said strips ahead of said second sealer and longitudinally along said strips to an extent that its exit end extends beyond said second heat sealer to deposit a liquid into said tubular structure;
6. means for pumping liquid into said filler tube at a rate commensurate with the rate of movement of said strips along said path;
7. a rotary cross-sealer including a plurality of pairs of opposite heating and pressure applying members movably into engagement with said liquid-filled tubular structure at regularly spaced transverse sections thereof as the structure is advanced, said members being adapted to transversely bond the heat sealable coatings of said strips together at spaced transverse sections to form a succession of connected liquid-filled compartments; and
8. chopping means for severing said compartments from one another intermediate said transverse bonded sections to form a plurality of individual liquid-filled pods.

19. An apparatus as defined in claim 1, wherein said second heat sealer is spaced along said path from said mid-sealer.

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