United States Patent

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[45] Patented **Aug. 3, 1971**
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[54] **PACKAGING PROCESS AND APPARATUS**
40 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** 53/28, 53/29, 53/180, 53/183
[51] **Int. Cl.** **B65b 9/02**
[50] **Field of Search** 53/28, 180, 29, 183; 106/213

[56] **References Cited**
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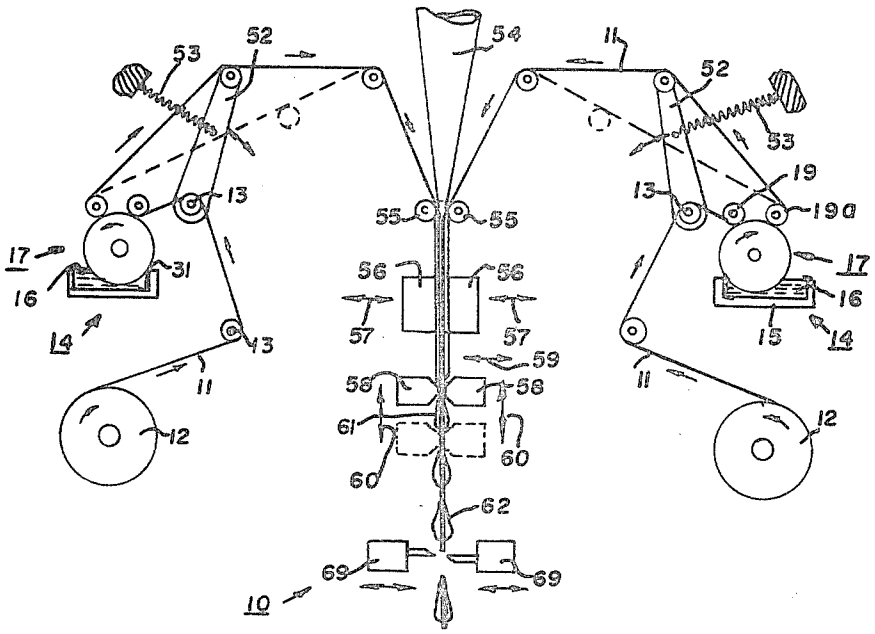
ABSTRACT: A process and apparatus particularly adapted for packaging food stuff in a water-soluble and preferably edible starch film manufactured to certain specified characteristics which for the first time makes it possible to form a water-soluble package sealed with a solvent activator such as water which is applied in a controlled manner to the film to preserve its strength so that tension may be applied to advance the film through a high-speed automatic packaging machine.



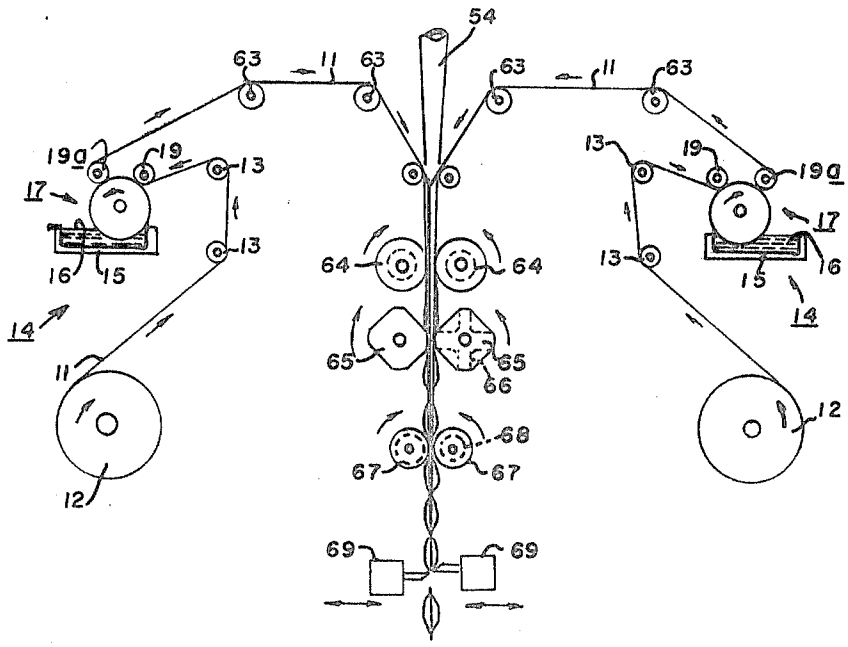


Fig. 2

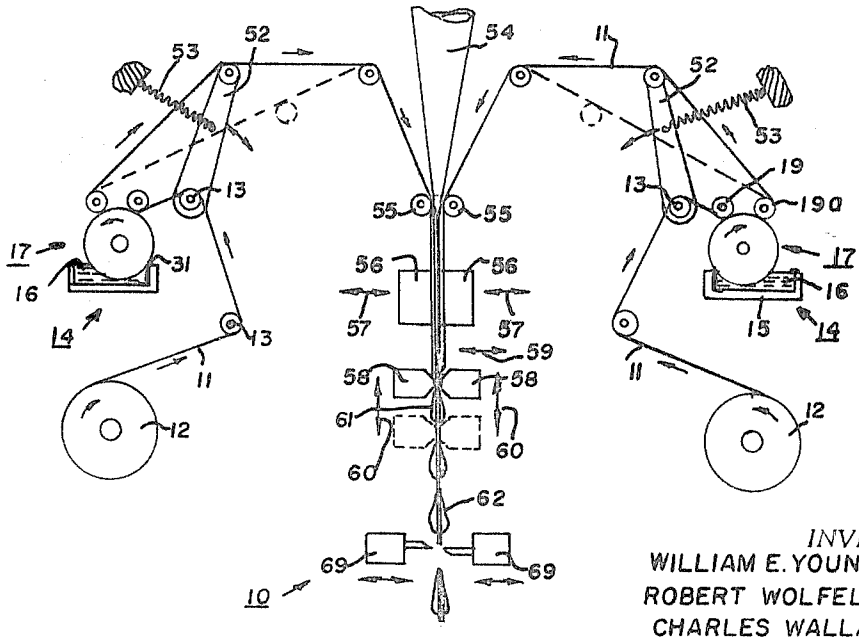


Fig. 1

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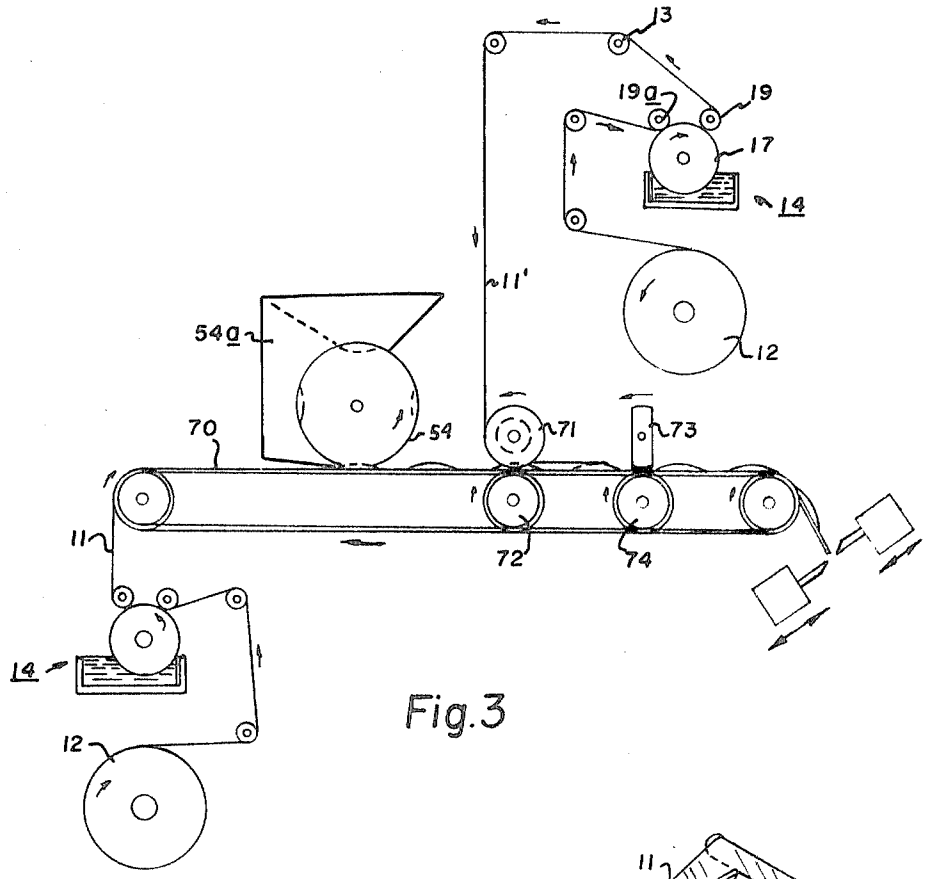

Fig.3

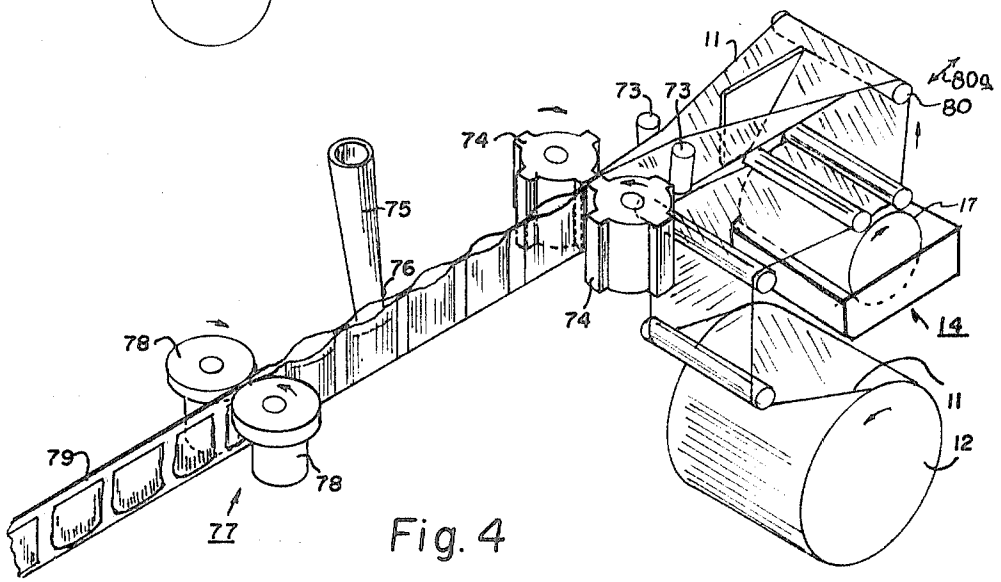

Fig. 4

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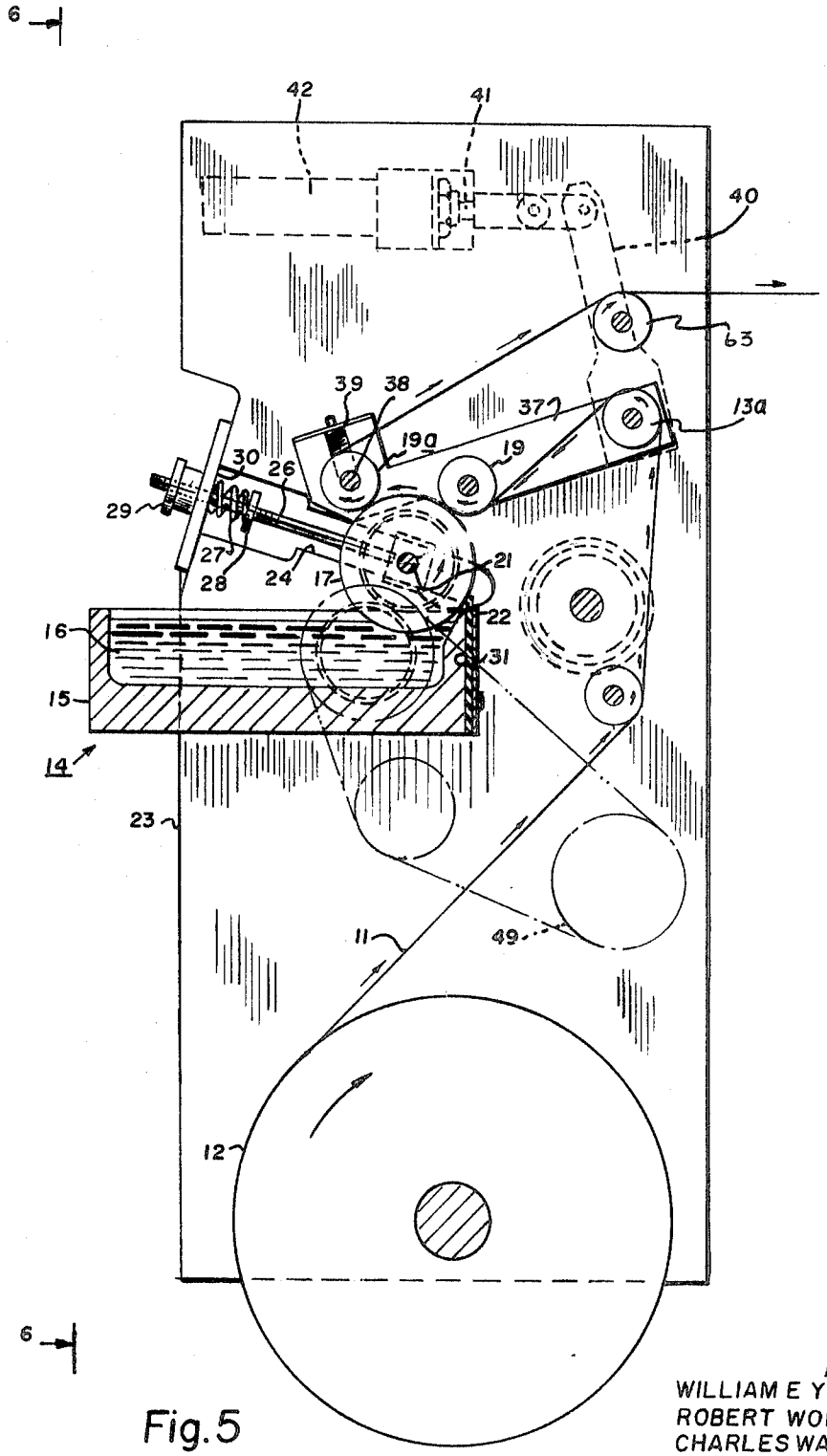

Fig.5

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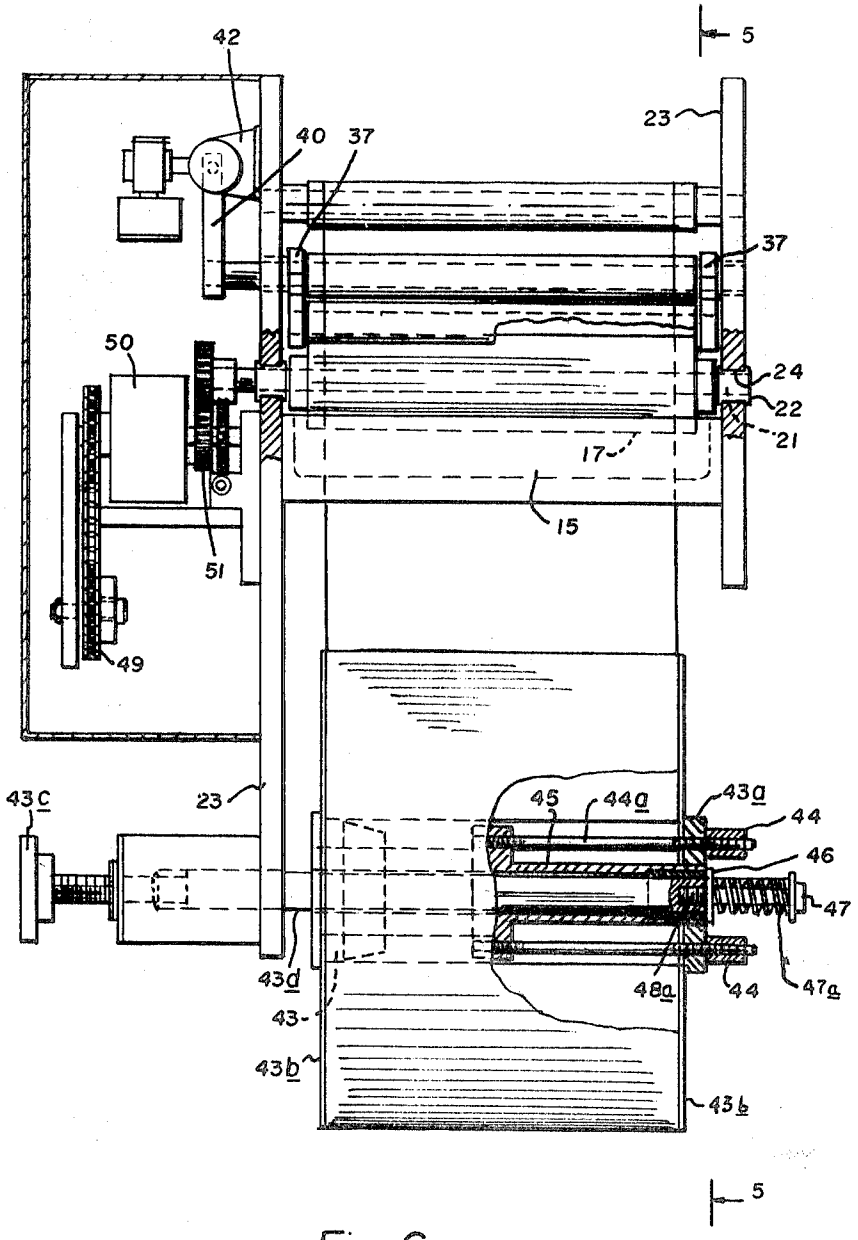

Fig. 6

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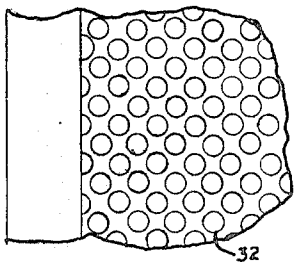

Fig.9

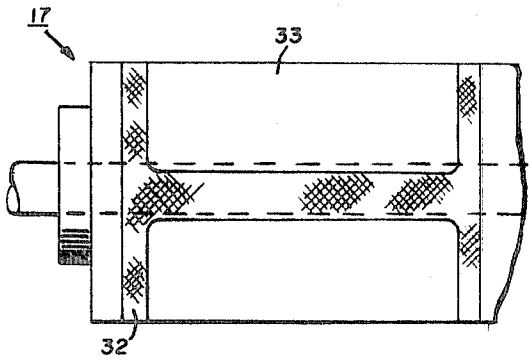

Fig. 7

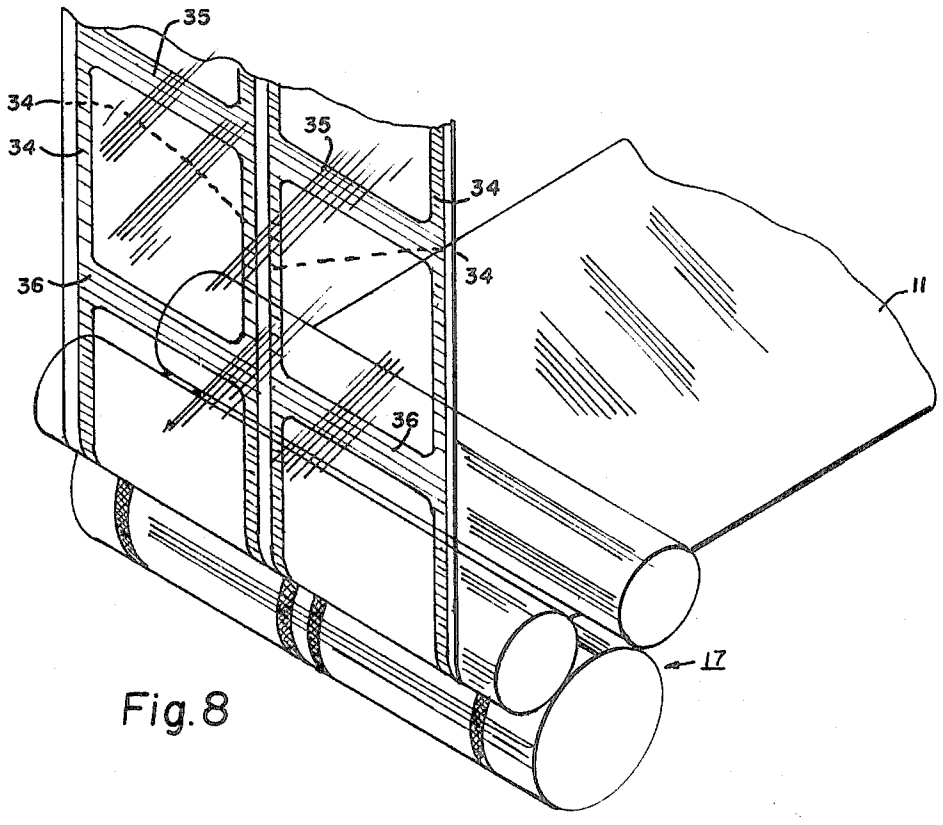

Fig.8

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PACKAGING PROCESS AND APPARATUS

This invention relates principally to a method and apparatus for making a flexible package from a water-soluble and preferably edible starch film.

Water-soluble starch film has been previously suggested as a packaging material but it has not up until now enjoyed any measure of commercial utility. One of the reasons for this is that water-soluble starch film is not a true thermoplastic material and it therefore cannot be sealed in conventional manner by heat and pressure alone. The water-soluble starch film is perhaps a pseudothermoplastic film in that it is flexible and can be softened by heat and pressure but it cannot be sealed by heat alone because the heated film when cool becomes brittle and the seal so readily fractures that it is unsuitable in a commercial package.

This problem of sealing the water-soluble starch film has been overcome in accordance with the present invention by means of a solvent such as water which so activates and tackifies the surface of the film that a perfectly acceptable commercial seal may be formed by merely pressing the activated surfaces together to form a cold weld seal in the package. If desired, moderate heat may be employed along with the solvent activator in forming the seal in the package.

The difficulty with a solvent activator is that it dissolves the film or otherwise so destroys the tensile strength that the film cannot withstand the tension and manipulation to which it is subjected as it moves through a high-speed automatic packaging machine. This difficulty was successfully overcome by manufacturing the water-soluble starch film to certain specified physical characteristics and by applying the solvent activator to the film in such a controlled manner as to maintain the tensile strength required for advancing the film through the high-speed packaging machine.

In accordance with the present invention, the water-soluble starch film must have a minimum tensile strength of at least about 500 p.s.i. as measured in conventional manner by the American Society of Testing Materials 1967 Test No. D747—63. But strength alone is not enough and the water-soluble starch film must also be flexible and possess that attribute of body stiffness required for manipulation in high-speed packaging machines. To this end, the water-soluble starch film must have a minimum stiffness of about 2.5 grams as measured by a Handle-O-Meter test with a sample of starch film 2 mils thick and 4 inches wide pushed into a one-half centimeter slot in conventional manner. This Handle-O-Meter test is described in Federal Specification UU—P—556 and as there described, a sample of film of selected width is placed on a flat plate over a slot. The film is then pushed down into the slot by a bar and the force necessary to push the film into the slot is measured on a strain gauge and reported in grams. A change in width of the sample of a given starch film employed in the test will change the reading on the strain gauge but the film will still have a stiffness equivalent to that of the 4-inch sample referred to hereinabove.

U. S. Pat. No. 3,243,308 describes an extrusion process for preparing a water-soluble starch film with the above physical characteristics. As described in this patent, the film may be made with a mixture of a high amylose starch derivative mixed with water. A plasticizer is preferably added to the mix to give better control of the flexibility and strength of the extruded film. By following the teaching of this patent, one skilled in the art of starch chemistry will have no difficulty in manufacturing a water-soluble starch film with the specified physical properties required for carrying out the present invention. While extruded high amylose water-soluble starch film is a preferred material, a cast water-soluble starch film made in conventional manner to have the specified physical properties may also be employed in the present invention.

The application of solvent activator to the water-soluble film in a controlled manner to seal the package is important for preserving the tensile strength of the film at the level required to withstand the stress of manipulation in the high-speed packaging machine. Water-soluble starch film is extremely sensistive to water and a change in room humidity may make it necessary to change the amount of solvent activator in order to form an acceptable commercial seal or to avoid dissolving the film to the point where it is so weak that it will rupture in the machine. Additives such as gums, dextrine or glycerine may be employed in the solvent activator to combat change in room humidity but these additives do not eliminate the need for controlled application of the solvent activator.

In accordance with the present invention, the solvent activator is preferably applied to the film in the form of discrete droplets which readily give the control required to insure that enough tensile strength remains in the film in the activated area to subject the film to high-speed manipulation and tension and yet be sure that the film surface has been rendered sufficiently tacky to achieve a high-strength cold weld seal between two or more strips or folds of film. Preservation of the tensile strength of the film by controlled deposition of discrete droplets of solvent activator renders the film eminently suitable for use in a high-speed packaging operation wherein tension is applied to the solvent-activated film to move it relative to the packaging machinery while the package is formed, filled and sealed in the machine without rupture. The reason why the discrete droplets of solvent activator are of particular advantage is not yet fully understood but the currently favored view is that the deposition of discrete droplets followed by a spreading of the activator on the surface of the film from one droplet to another gives a very precise control of the amount of activator applied to the film and it tends to restrict objectionable solvent action of the activator to the isolated spots of the droplets which in turn tends to preserve the tensile strength of the film at the required level in high-speed packaging operations. The spreading out of the droplets of solvent activator on the surface of the film may take place at the time the package is formed or prior thereto. These are presently favored viewpoints but new and different reasons for the above behavior may later be shown to account for the advantages derived from this particular method.

Water-soluble starch film is generally stretched during manufacture or otherwise given an internal stress orientation in at least one direction. When this is the case, the amount of solvent activator deposited on the water-soluble film may be readily controlled and it may not be necessary to deposit the solvent activator on the film in the form of discrete droplets. If an excess of solvent activator is applied to the water-soluble starch film striations appear on the surface of the film as a plurality of ridge lines and valleys running in a direction generally parallel to the stress orientation. Bubbles may appear as areas of relaxation wherein the film in the area of activation appears to be loose when the film is pulled tight. Why this occurs is not fully understood at the present time but it is thought to be a function of overrelaxation of stress in the film when too much activator is applied to the film. As a result, the oriented water-soluble starch film has a built-in warning system so that when striations or bubbles appear too much activator has been applied. Of course, visual examination of the finished package will show if enough activator has been applied for a satisfactory seal.

For best results, discrete droplets of activator are deposited on the film surface by a roll which has an etched or engraved surface. The roll is rotated through a bath containing the activator solution and the film is run against the roll under slight tension. The roll deposits discrete droplets of activator on the surface of the film in accordance with the etch pattern on the roll. The etched roll is a conventional intaglio roll of the type used in printing operations and the amount of solvent activator deposited on the water-soluble film is determined by the screen rating of the roll which is the standard for intaglio rolls that determine the number and size of the depressions in the roll.

It has been found that for films ranging in thickness from one-half mil up to about 5 mils, an etched roll having an etch spacing of 150 depressions per linear inch (150 screen) gave

excellent results, generally regardless of the thickness of the film. An etched roll with a screen rating from about 30 to 230 may also be used depending on the selected film and solvent activator at hand. When using a roller having 150 depressions per linear inch to apply water as the solvent activator to an area of about 3 square inches out of a total area of about 8 square inches of film 2 mils thick at about 50 percent relative humidity the weight of the film increased about 5 percent and a satisfactory seal was formed.

In general, an adequate seal may be obtained if the solvent activator increases the weight of the above-specified section of film from about 2.0 percent to about 15 percent. It can be appreciated however that as the thickness of the film is increased, the amount of solvent activator applied to the film may also be increased without objectionable loss in film strength and as brought out above a change in humidity may also require that a change be made in the amount of solvent activator applied to the film. A change in the composition or the ingredients used in making the starch film will also change the amount of solvent activator which may be deposited on the film and it is therefore virtually impossible to specify the exact amount of solvent activator to use under all circumstances. In general, however, the amount of solvent activator should be at least enough to tackify the film surface to make it adhesive and the film should not be completely dissolved in the solvent activator.

It is to be understood that the etch pattern on the surface of the roller and the size of the depressions can be changed to deposit more or less activator as desired in a particular application. The amount of solvent activator applied to the film may also be changed by varying the time of film contact with the roller. This is preferably done by changing the angle of contact between the film and roller. When the film is run tangent to the roll surface a line contact is established which deposits a minimum amount of solvent activator on the film surface. When the film forms a 90° angle in contact with the roller, the time of contact between film and roller increases with a corresponding increase in the amount of solvent activator deposited on the film. This feature may in some applications eliminate the need to change rollers to different ones having a smaller or larger depression in the etch pattern in order to change the amount of activator deposited on the film.

In most packaging operations, it is contemplated that the etched roll and supply roll of film will be driven at a constant speed to eliminate any unnecessary application of tension to the film beyond that required to advance the film through the packaging machine. After the solvent activator has been applied to the film in the desired pattern for forming the package, the film is advanced through the selected high-speed packaging machine where the package is formed, filled and sealed. One outstanding advantage of the present invention is that the tensile strength of the water-soluble film is maintained at the level required to withstand high-speed manipulation experienced in forming the package and the film may be drawn through the machine under tension and filled without the necessity of special supports to prevent its rupture under stress. While the present invention is of particular advantage in connection with forming packages of water-soluble starch film, it will be understood that the invention may also be utilized to form packages from any known water-soluble film which does not include starch as an ingredient thereof.

As used in the specification and claims, the term solvent activator is intended to mean any liquid which is capable of exerting solvent action on the water-soluble film to the extent that the surface of the film is at least tacky and capable of cohering to itself or adhering to another dissimilar surface. Water is the preferred solvent activator but organic alcohols and other known solvent adhesives may also be used and if desired additives such as glycol, dextrine or gums may be added to the solvent activator.

Referring now to the drawings wherein various preferred embodiments of the invention are shown and in which like numerals refer to like parts:

FIG. 1 is a schematic view of an intermittent packaging machine wherein a package is made from two strips of film.

FIG. 2 is a schematic view of a rotary (nonintermittent) packaging machine wherein a package is made from two strips of film.

FIG. 3 is a schematic view of a packaging machine in which the weight of the completed package is supported.

FIG. 4 is a schematic view of a packaging machine wherein the package is formed from one strip of film.

FIG. 5 is a side view of a preferred form of applicator assembly.

FIG. 6 is a front view of the preferred form of applicator assembly.

FIG. 7 is a front view of an etched applicator roll.

FIG. 8 is an isometric view of another form of applicator.

FIG. 9 is an enlarged detail view of one form of the applicator roll etch pattern.

Referring to FIG. 1, there is seen an intermittent packaging machine **10**. Two strips of film **11** are fed from storage rolls **12** under tension over idler rolls **13** by an applicator indicated generally at **14** in a manner to be described hereinafter. Idlers **13** change the direction of film travel between the storage roll **12** and applicator **14**.

Referring now to FIGS. **5**, **7** and **8**, there is seen an applicator indicated generally at **14** which has a positively driven applicator roll **17** mounted therein. Applicator roll **17** pulls film from the storage roll **12** in a manner to be hereinafter described. The applicator roll **17** is preferably of the intaglio type and has an etched surface **32**. The positively driven applicator roll **17** rotates in trough **15** and picks up solvent activator **16**, preferably water with or without an additive such as ammio gum, dextrine or glycerine, in a plurality of depressions **32** termed "screen," which depressions are preferably below the surface **33** of the roller **17** (FIG. 7). In the preferred applicator, there are between 30 and 230 depressions to the linear inch although 150 screen is most preferable, generally regardless of film thickness.

The particular pattern of depressions shown on the roller **17** in FIG. 7 is used to apply solvent activator to strips of film from which small, square packages are to be made. However, any pattern may be used depending on particular packaging needs.

As shown in FIG. 8, the particular pattern disclosed in FIG. 7 is repeated twice on a modified roll and imprints a double pattern on film **11** which is preferably a water-soluble starch film. The pattern imprinted consists of a pair of longitudinal imprints **34**, and a pair of cross imprints **35** and **36**. The applicator roll however may have the pattern repeated any number of times or even have a plurality of different patterns etched thereon.

The film **11** is drawn from storage roll **12** by positively driven applicator roll **17** which deposits discrete droplets of solvent activator on the surface of the film in accordance with the pattern and screen rating **32** of the applicator roll. As the film is manipulated by the packaging machine in its passage from the applicator roller **17** to the various other parts of the machinery, the droplets tend to spread out and run together either before or during the time the solvent activated areas of the films are pressed together to form a seal.

The applicator roll **17** is mounted on shaft **21**, the shaft being in turn mounted in a pair of bearing blocks **22**. The bearing blocks **22** are slidably mounted in machined slots **24** in frames **23**. Threaded rods **26** are secured in each of the two bearing blocks **22** on either side of applicator roll **17** and extend through holes in each of two retainer plates **30** for a purpose described hereinafter. The retainer plates **30** are rigidly affixed to frames **23**. Springs **27** are mounted coaxially on the threaded rods **26** between the retainer plates **30** and a rotatable knurled nut **28**. The knurled nut **28** moves up or down the threaded nut **26** depending on which way it is rotated to increase or decrease the length of springs **27**. If the knurled nut **28** is rotated so as to move it upwardly towards the retainer plates **30**, the spring **27** will be compressed. The springs **27**

urge the assembly of threaded nut 26, bearing blocks 22 and applicator roll 17 against a doctor blade 31, the force urging the assembly against the doctor blade being a function of the compressed length of springs 27 which is a function of the position of the knurled nut 28 against which the springs 27 act.

A second pair of knurled nuts 29 are rotatably mounted to the end of the threaded rods 26 and bear against retainer plates 30. Knurled nuts 29, when rotated, raise and lower the combination of threaded rods 26 and bearing blocks 22 to accommodate varying size applicator rolls 17. Therefore, by rotating the knurled nuts 29 to raise the threaded rods 26, a larger size applicator roll 17 can be accommodated. The knurled nut 28 can then be rotated to change the compressed length of springs 27 to change the force exerted by the applicator roll 17 on doctor blade 31, to any desired level.

In the present application, the level of solvent activator 16 in the trough 15 is of no importance. All that is necessary is that the etched surface 32 of applicator roll 17 be below the surface of solvent activator 16 in trough 15 to assure that the etched surface 32 of the applicator roll 17 will always be picking up solvent activator in the etched areas. Doctor blade 31 scrapes the surface of the applicator roll 17 as the applicator roll rotates to confine solvent activator to only the etched areas of the applicator roll 17.

The pressure rolls 19 and 19*a* (FIG. 5) are mounted on pressure bars 37. Pressure roll 19*a* has its bearing 38 spring loaded downwardly by spring 39 to apply pressure to applicator roll 17. Pressure roll 19, also mounted to pressure bars 37, is positionally fixed relative to the pressure bars. The pressure bar 37 is pivotally mounted to side frame 23 through the shaft of idler roll 13*a*.

Pressure rolls 19 and 19*a* apply pressure to the film 11 as it passes between the pressure rolls 19, 19*a* and applicator roll 17 to keep the film in contact with the etched surface of roller 17 and are adjustable with respect to the applicator roll so that the angle of contact of film to roller can be varied as described hereinafter.

Mounted to pressure bars 37 at shaft 13*a* is a bellcrank lever 40. The bellcrank lever 40 is pivotally mounted to a piston 41 which forms a part of air cylinder assembly 42. When the air cylinder is activated so as to move the piston 41 rightwardly as in FIG. 5, the bellcrank lever 40 is pivoted clockwise about shaft 13*a* carrying pressure bar 37 with it in a clockwise direction to lift pressure rolls 19 and 19*a* from the applicator roll 17 to allow the film 11 to move out of contact with the applicator roll 17. This is of particular advantage when, for any reason, the packaging operation is stopped because if the now stationary film were allowed to remain in contact with the applicator roll 17 for too long, the solvent activator carried therein would probably dissolve the film.

Piston 41, when moved leftwardly to cause bellcrank lever 40 to rotate in a counterclockwise direction, causes pressure bar 37 to also rotate in a counterclockwise direction about shaft 13*a* to cause pressure roll 19*a* to ride up against the pressure of spring 39 to press film 11 against applicator roll 17. The counterclockwise movement of pressure roll 19 is continued to increase the wrap, or angle of contact of film 11 to applicator roll 17 until the pressure roll 19 also contacts applicator roll 17 at which point there can be no further increase in the angle of contact.

Functionally, control over the angle of contact of film to applicator roll for a given constant speed of rotation of the applicator roll allows an increase or decrease in dwell time, i.e., the amount of time a particular section of the film is in contact with the applicator roll. The longer the film is in contact with the applicator roll, the greater the amount of solvent activator absorbed by the film surface and vice versa. Therefore, the applicator roll 17 can be used to activate film having different thicknesses without changing to an applicator roll having a different screen size to vary the amount of solvent activator deposited on the film.

I have found it preferable to apply drag to the film storage rolls 12 to prevent the film from being indiscriminately pulled from the storage roll by the rotating applicator roll 17. To this end, storage roll 12 is mounted on a pair of hubs 43 and 43*a*. Hub 43*a* is held in place by a pair of thumb nuts 44 mounted to studs 44*a*. The studs 44*a* are at their ends opposite the thumb nuts 44 mounted to a brake hub 45. An adjustable brake disc 46 is urged against shaft 43*d* and applies drag to the storage roll 12 by applying pressure to brake hub 45. The amount of drag applied can be varied by adjustment screw 47 which is mounted on shaft 43*d*. The adjustment screw 47 has a threaded portion 48*a* in brake hub 45. Mounted between the head of the adjustment screw 47 and brake disc 46 is a spring 47*a* which applies force to brake disc 46 when the adjustment screw 47 is tightened, thereby increasing the drag force between brake disc 46 and brake hub 45 to increase the amount of drag applied to the storage roll 12.

The film from the storage roll 12 is guided by side plates 43*b* and the whole assembly may be moved leftwardly or rightwardly to center the storage roll by adjustment nut 43*c* which is mounted to a nonrotating shaft 43*d* on which the whole storage roll assembly is mounted.

Applicator roll 17 is driven from the packaging machine drive (not shown) which also drives the machine seal bars 56 and 58 as described hereinbelow, through sprocket drive assembly 49. Interposed between sprocket drive assembly 49 and applicator roll 17 is a plurality of gears indicated by the rectangular box 50 which houses a differential assembly (not shown). Attached to floating shaft 21 is a plurality of gears 51 which transfer drive motion from the differential assembly 50 to the floating shaft 21 which in turn transfers the drive motion to applicator roll 17. The applicator roll 17 is driven off the machine drive in order to supply solvent activated film to the packaging machine at a rate consistent with the speed of packaging. Therefore, if the packaging speed is increased, so is the speed of rotation of the applicator roll 17.

The differential assembly provides a running register control whereby applicator roll 17 can be rotationally advanced or retarded without increasing its speed of rotation with respect to the packaging machine to bring solvent activated film areas into sealing alignment with the machine seal bars so that the seal bars do not operate on unactivated film areas. This is done during machine operation and does not require that the machinery be stopped.

Returning now to the embodiment of FIG. 1, the film 11 passes from the driven applicator roll 17 to a dancer bar 52. Dancer bar 52 is used to couple the applicator assembly to intermittent packaging machinery and is not necessary on rotary or any nonintermittent-type machinery. The dancer bar 52 is mounted to a spring 53 which is in turn mounted to any stationary portion of the machine assembly. The operation of the dancer bar will be hereinafter described.

From the dancer bar, the activated film 11 is fed to a packaging machine indicated generally at 10. The two strips of film 11 are passed in close proximity to a fill tube 54. Rolls 55 bring the film strips 11 in close to the fill tube 54. From the rolls 55, the film is fed between a pair of side seal bars 56 which move in the direction indicated by the arrow 57. The side seal bars 56 make the longitudinal seals along imprints 34 (FIG. 8) by applying pressure to the two strips of film 11 with or without heat to cause the two strips of film to weld together.

After the side seals along imprints 34 (FIG. 8) have been made, the film strips advance to the next station where a first cross seal along imprints 36 (FIG. 8) is made by cross seal bars 58. Cross seal bars 58 move in toward the film strips 11 as indicated by arrow 59 to apply pressure to the film with or without the application of heat to effect the cross seal along imprints 36.

At this point, fill tube 54 is operated to release a predetermined amount of material with which the now partially sealed package envelope is to be filled against the first cross seal along imprints 36. The cross seal bars 58 then, either conjointly with the filling operation or before or after the filling operation, move downwardly as indicated by arrows 60 while still applying pressure to the film to pull the now partially

completed package envelope **61** under tension to the position indicated by the dotted outline of cross seal bars **58**. At this point, cross seal bars **58** release their pressure and move outwardly away from the film and then upwardly to the original position at which point the process begins all over again. However, the second cross seal along imprints **35** (FIG. **8**) that is made by the cross seal bars **58** as the closing seal to complete the package **62** also serves as the first cross seal for the next package. The packages are then advanced under tension out of the packaging machine and may be severed from preceding packages by reciprocating knives **69**.

Because the packaging machine operates intermittently, the film is intermittently loaded in tension during the packaging operation. This is especially true because the applicator roll **17** is driven at a constant rate of speed so that as the film advance stops to allow the machine to make the side seals along imprint **34**, applicator roll **17** is still feeding film which will tend to form in a loose, looplike pattern. When film advance is resumed, the film slack would be quickly removed and the film shock loaded. In the present invention, as the cross seal bars pull the package **61** downwardly, the dancer bar is moved in clockwise rotation about idler **13** to its dotted line position. The clockwise movement of the dancer bar **52** extends the spring **53** so that when the cross seal bars **58** stop their downward travel, the dancer bar begins to rotate in a counterclockwise direction to take up the slack in the film caused by the constant film feed rate of the applicator roll **17**. The dancer bar therefore keeps constant tension on the film and eliminates undesirable loop formation and shock loading of the film.

Referring now to FIG. **2**, there is shown a typical rotary packaging process. The applicator assembly **14** and storage roll and brake assembly as described for FIG. **1** are exactly the same for this and subsequent processes described herein and for the sake of brevity will not be redescribed.

In this process, film **11** is fed from storage roll **12** past idlers **13** to applicator assembly **14** where solvent activator is applied to the film as previously described. From the applicator **14**, the now-activated film **11** is run unsupported across idlers **63** under tension past fill tube **54** as described below. The activated film **11** is brought into close proximity to the fill tube **54** and into sealing alignment with each other by sealing rolls **64** which are positively driven. Sealing rolls **64** are driven at a constant rate of speed that is preferably slightly faster than the rate of speed that applicator roll **17** is driven at. This difference in speeds creates a small, controllable amount of tension in the film and assures that the film will not form a loop between the applicator roll **17** and the sealing rolls **64**.

In a particular package that is formed by two sets of seals to form a rectangularly sealed package, the seal members **64** form a continuous longitudinal side seal by applying pressure with or without the addition of heat to cause the two strips of film to cohere.

From seal members **64**, the now partially formed package is run to a second set of seal members **65**. Seal members **65** are, similarly to seal members **64**, positively rotated in the direction of film travel at a constant speed equal to or preferably somewhat faster than the speed seal members **64** are being rotated at to keep tension on the film.

Seal members **65** are generally cam shaped so as not to apply pressure to the film continuously and are formed in the shape of the area to be sealed, i.e., pressure is not applied by seal members **65** to the film when an unactivated portion of film is passing through the seal members. Therefore, seal members **65** contact the film intermittently but, because they are rotating in the direction of film travel, do not cause any undue intermittent shock loading of the film other than the shock that would be present due to the preferably slightly faster speed of the seal members **65**. The cross seal bars **65** are also relieved in their central portions to allow the filled, partially sealed package envelopes to pass unobstructed between the seal bars **65**.

Seal members **64** have reduced diameters in their central portions as indicated by the dotted lines whereby the diameter of the seal members **64** in their central portions is reduced so the central portion of the film strips pass unsealed to seal members **65**. The fill tube **54** extends downwardly between the activated film strips through the reduced central portion of the seal member **64**.

As seal members **65** rotate, a first cross seal along imprints **35** (FIG. **8**) is made against which fill tube **54** releases a predetermined amount of package fill. The filled package envelope is now completely unsupported and, while in this condition, is sealed again by seal members **65** to form a second cross seal along imprints **35** (FIG. **8**) to complete the package. The second cross seal along imprint **35** is also the first cross seal for the next subsequent package.

An alternate form of seal member is indicated at **66** wherein those portions of the seal member not necessary to the sealing operation have been removed to form a simple, cross-shaped block. It is contemplated that any form of seal member may be used to apply pressure to complete the cross seals, with or without the addition of heat.

Positioned below the seal members **65** is a pair of draw rolls **67**. Draw rolls **67** are positively driven and rotate in the direction of package travel to pull the completed packages under tension away from the seal members **65**. The draw rollers are of less diameter at their central portions as indicated by the dotted line **68** so as not to apply any pressure to the portion of the package containing the fill material. However, it is contemplated that in some applications the machine can be operated without the use of draw rolls **67** since the seal members **65** force the packages downwardly as a natural result of their rotation.

Positioned below the draw rolls **67** is a cutting knife **69** wherein each half thereof reciprocates towards and away from the finished packages to sever them along the cross seal. However, it is contemplated that a cutting knife need not be used since in some applications it is desirable to maintain the integrity of the string of packages.

Referring now to FIG. **3**, there is shown another process for making packages from water-soluble film. Basically, the applicator **14** is the same as that described above and for brevity, will not be redescribed. In this process, film **11** is fed under tension from storage roll **12** to applicator **14** which applies a controlled amount of activator to the film in a predetermined pattern as described in the previous embodiments. The activated film **11** is then fed to endless belt **70** and is directed along the surface of the endless belt. Fill roll **54** rotates in fill reservoir **54***a* and releases a predetermined amount of package fill on to the moving film. From this point the film carrying the package fill is moved to another station in which a second strip of film **11'**, which may or may not be activated, is brought into sealing alignment with film strip **11**. A side seal is then made by rotatable seal member **71** by applying pressure with or without heat to the two strips of film **11**, **11'** against endless belt **70**, which is supported by rotatable support **72**. Rotatable support **72** and seal members **71** rotate continuously and conjointly to move the partially completed package envelope to another sealing position on the endless belt where rotatable seal member **73** applies pressure against rotatable support **74** via the endless belt to form the final cross seal and complete the package. The rotatable seal members **71**, **73** are similar in structure and function to the seal members **64** and **65** of FIG. **2**. However, it is contemplated that seal members **71**, **73** may be composed of two sets of seal members, one to make the side seals and one to make the cross seals similar to those shown in FIG. **1**. It is further contemplated that the seal member **71** be eliminated and the seal member **73** apply the side seals as well as the cross seals simply by making the edges of seal member **73** circular and of greater diameter than the inner portion of the seal member so that the edges contact the film to make the side seals as described above and making the inner portion of the seal member **73** in the form shown in the drawing whereby the side and cross seals may be made by only

one seal member. It is also contemplated that advance of the completed package out of the machine be accomplished by a plurality of draw rolls instead of solely by the seal member 73.

FIG. 4 depicts another type of packaging machine wherein the package is to be formed from a single strip of film. This particular process concerns itself with making an unsupported package sealed on at least three sides but it is contemplated that the single strip of film may also be used to form a tube therefrom and sealed only axially on the circumference thereof.

In the process of FIG. 4, film 11 is fed from storage roll 12 to an applicator indicated generally at 14 and is similar to the process of the previously described embodiments and will not be here-described again. From the applicator 14, the film is run between a pair of idler pins 73, which fold the film in upon itself. From the idler pins 73, the folded film passes between a pair of positively driven seal bars 74 which vertically seal the film. The seal bars 74 also intermittently pull the film 11 under tension from the positively driven applicator roll 17. To prevent loop formations in the film, idler roll 80 is movable in the direction of the arrow 80*a* and performs the function of the dancer bar illustrated in FIG. 1. The structure of the dancer bar system in this embodiment is similar to the FIG. 1 embodiment and for the sake of brevity and compactness will not be here redescribed or its structure reshown. The vertical seal made by seal bars 74 only extends to a point slightly below the open end of the partially completed package envelope. One or more fill tubes 75 is used to fill the partially sealed package envelope and the neck 76 of the fill tube 75 preferably extends below the open end of the package envelope to keep the package envelope open. The bottom edge of the folded film may be sealed if this is so desired by applying pressure with or without the application of heat to the film before filling the package envelope.

From the seal rolls 74, the folded film advances to sealing station 77 which comprises a pair of intermittent sealing members 78 which applies the final seal to the package at 79. The seal members 78 rotate in conjunction with the seal members 74 and are intermittent to allow the film advance to stop so that the package envelope can be filled. Seal bars 78 can also be similar in structure and function to seal members 58 of FIG. 1. Also, pulling force for moving the final package out of the machine may be provided by separate draw rolls (not shown) in addition to the pulling force on the film occasioned by the seal rolls 78. It is also contemplated that the process need not be intermittent but can be rotary if the seal bars of the embodiment of FIG. 2 are used instead.

All the processes described herein are unsupported packaging operations in which the film is required to support the weight of a completed package or the force of a completed package being moved under tension away from the sealing portion of the packaging operation. Any water-soluble film can be used as long as the film is manufactured to have a minimum tensile strength of 500 p.s.i. and a maximum 2.5-gram stiffness factor as set forth above and is activated by applying controlled amounts of solvent activator to the film as set forth hereinabove. It is also contemplated that any activator having solvent action on the film can be used, including glues.

It will be understood that it is intended to cover all changes and modifications of the preferred embodiments of the invention, herein chosen for the purpose of illustration, which do not constitute departures from the spirit and scope of the invention.

We claim:

1. A process for manufacturing packages made with water-soluble film having a tensile strength of at least about 500 p.s.i. and a stiffness of at least about 2.5 grams in a machine of the type which includes an applicator for applying solvent activator to the film which comprises the steps of applying tension to such film to advance it through the machine, applying a controlled amount of solvent activator to preselected areas of such film before any part of the package is formed, moving portions of said film into a sealing alignment with at least one of said portions being a preselected area, pressing said portions together to form a seal and a film package envelope open at one end thereof, filling the package through the open end thereof, pressing second portions of said film together at least one of which is a preselected area to seal the open end of the package and moving said filled package out of the machine.

2. A process as specified in claim 1 which includes the step of pressing one preselected area against another preselected area to form both of the said seals in the filled package.

3. The process specified in claim 1 further comprising the step of applying heat to said preselected areas of said film conjointly with the step of applying pressure to form said seal.

4. The process specified in claim 2 further comprising the step of applying heat to said preselected areas of said film conjointly with the step of applying pressure to form said seal.

5. The process specified in claim 1 further comprising the step of applying a solvent activator consisting of water to said film.

6. The process specified in claim 2 further comprising the step of applying a solvent activator consisting of water to said film.

7. The process specified in claim 1 further comprising the step of applying a solvent activator consisting of water and an additive to said film.

8. The process specified in claim 2 further comprising the step of applying a solvent activator consisting of water and an additive to said film.

9. The process specified in claim 1 further comprising the steps of applying said solvent activator to said film in discrete droplets.

10. The process specified in claim 2 further comprising the steps of applying said solvent activator to said film in discrete droplets.

11. The process specified in claim 9 further comprising the step of applying between 30 and 230 discrete droplets per linear inch to said preselected areas of said film.

12. The process specified in claim 10 further comprising the step of applying between 30 and 230 discrete droplets per linear inch to said preselected areas of said film.

13. The process specified in claim 1 further comprising the step of advancing the filled package out of the machine such that the film following the package completely supports the weight of at least one filled package.

14. The process specified in claim 2 further comprising the step of advancing the filled package out of the machine such that the film following the package completely supports the weight of at least one filled package.

15. A process for manufacturing packages made with at least two strips of water-soluble starch film each having a tensile strength of at least about 500 p.s.i. and a stiffness of at least about 2.5 grams in a machine of the type which includes an etched roll for applying water to the film strips to make it adhesive which comprises the steps of: applying tension to a first strip of such film, applying between 30 and 230 discrete droplets of water per linear inch to preselected areas of at least one of said film strips to activate and tackify the surface thereof before any part of the package is formed, moving said first and a second strip of film into sealing alignment with each other by the continued application of tension to the said film strips, pressing a portion of said first and second strips of film together to form a longitudinal seal between the two strips of film along a line at opposite ends thereof, pressing said two strips of film together to make a first cross seal across the film strips between said longitudinal seals to form a package envelope open at one end thereof, filling the package envelope by depositing material between said longitudinal seals and against said first cross seal, moving said package envelope under tension to another station and pressing said two strips of film together to make a second cross seal and form a final package and moving said final package out of said machine by the application of tension to said film strips.

16. A process as in claim 15 wherein 150 discrete droplets per linear inch are deposited on said film strip.

17. A process as in claim 16 wherein the 150 discrete droplets per linear inch are deposited on both strips of film.

18. A process as in claim 17 further comprising the step of stopping the film advance during the time that pressure is applied to the strips of film to form a seal.

19. A process for manufacturing packages made with at least two strips of water-soluble starch film having a tensile strength of at least about 500 p.s.i. and a stiffness of at least about 2.5 grams in a machine of the type which includes an etched roll for applying water to the film to make it adhesive which comprises the steps of: applying between 30 and 230 discrete droplets of water per linear inch to at least one of said film strips to activate and tackify the surface thereof before any part of the package is formed, moving said first and a second strip of film into sealing alignment with each other, pressing a portion of said first and second strips of film together to form the package for material contained therein.

20. A process for manufacturing packages made with at least two strips of water-soluble film having a tensile strength of at least about b 500 p.s.i. and a stiffness of at least about 2.5 grams which includes an applicator for applying water to the film which comprises the steps of: applying tension to a first strip of such film applying solvent activator to preselected areas of at least one of said film strips to activate and tackify the surface thereof before any part of the package is formed, depositing material on one of said strips of film, bringing said strips of film into sealing alignment and applying pressure to said strips of film to seal said package and moving said package out of said machine under tension.

21. An apparatus for manufacturing packages made with water-soluble film comprising means for applying tension solely to the water-soluble film to advance it through the apparatus, means for applying a controlled amount of activator in the form of discrete droplets to preselected areas of said film before any part of the package is formed, sufficient to activate the surface of the film but insufficient to reduce the strength of the film below that needed to withstand the tension forces applied to the film, means for moving portions of said film into a sealing alignment with at least one of said portions being a preselected area, means for pressing said portions together to form a seal and a film package envelope open at one end thereof, means for filling said package envelope through the open end thereof, means for pressing second portions of said film together at least one of which is a preselected area to seal the open end of the package envelope and means for applying tension to move the final package out of the apparatus.

22. An apparatus as specified in claim 28 wherein said means for applying a controlled amount of activator to preselected areas of said film comprises an etched roll having a screen rating of between 30 and 230, said roller being positively driven at a speed consistent with the speed of applying pressure to seal said packages, said etched roll being rotatable through a solvent activator bath whereby solvent activator is picked up in the etched area of said roll for deposition on said film, means for keeping the film in contact with said etched roll and means for removing excess solvent activator from the surface of said etched roll to confine the solvent activator only to the etched areas of said roll.

23. An apparatus as in claim 22 wherein said screen rating is 150.

24. An apparatus as in claim 22 further comprising means for adjusting the angle of contact of said film to said etched roll to vary the time the film is in contact with said roll.

25. An apparatus as specified in claim 21 further comprising means for applying heat to said film conjointly with said pressure to form a seal.

26. An apparatus as specified in claim 21 wherein said solvent activator is water.

27. An apparatus as specified in claim 21 further comprising means for applying solvent activator to preselected areas of each of two strips of film.

28. An apparatus as in claim 22 further comprising a dancer bar interposed between said etched roll and said means for pressing a portion of said preselected areas and film together to keep tension on said film and to prevent said film from forming into loops.

29. An apparatus as specified in claim 27 wherein said means for applying solvent activator to preselected areas of each of two strips of film comprises two etched rolls, each of said etched rolls being rotatable through a solvent activator bath whereby solvent activator is picked up in the etched area of each of said roll and deposited on said two film strips and means for pressing the preselected areas of each film strip together to form a seal.

30. An apparatus for manufacturing packages made with water-soluble film having a tensile strength of at least about 500 p.s.i. and a stiffness of at least about 2.5 grams comprising means for applying tension to the film to advance it through the apparatus, at least two etched rolls rotatable in a solvent activator bath, said etched roll having a screen rating of between 30 and 230 for applying solvent activator to at least two strips of film, said applicator pulling film from a storage roll, said etched rolls applying a controlled amount of solvent activator to said strips of film, means for bringing said preselected areas into sealing alignment with each other, a first set of sealing bars to apply pressure to seal a first portion of said film strips, at least one dancer bar interposed between said first set of sealing bars and said etched roll to take up slack in said film strips and to keep said film strips under tension, a second set of seal bars for pressing said film strips together to form a package envelope open at one end thereof, means for filling said package envelope through the open end thereof, said second set of seal bars pressing said strips of film together a second time to complete said package and means for moving said package out of said machine under tension.

31. A process for manufacturing packages of water-soluble film in a machine of the type which includes an applicator for applying solvent activator to the film to make it adhesive which comprises the steps of pulling at least a first and a second strip of such film through the machine, applying a controlled amount of solvent activator in the form of discrete droplets to preselected areas of at least one of said film strips to activate the surface and make it adhesive, moving said strips of film into sealing alignment with each other, pressing together a portion of at least two of said film strips including part of the preselected area to form a seal between the two strips of film and a packaging envelope with an opening therein, filling the package through such opening, pressing together a second portion of the same two film strips including part of the preselected area to seal the opening in the package and then removing said package from the machine.

32. The process specified in claim 31 which includes the step of applying between about 30 to 230 discrete droplets of solvent activator to preselected areas of at least one of said film strips.

33. The process specified in claim 31 which includes the step of applying heat to the film when it is pressed together to form a seal.

34. A process for manufacturing packages of water-soluble film in a machine of the type which includes an applicator for applying solvent activator to the film to make it adhesive which comprises the steps of pulling at least a first and a second strip of such film through the machine, applying a controlled amount of solvent activator which consists of water and an additive to preselected areas of at least one of said film strips to tackify the surface and make it adhesive, moving said strips of film into sealing alignment with each other, pressing together a portion of at least two of said film strips including part of the preselected area to form a seal between the two strips of film and a packaging envelope with an opening therein, filling the package through such opening, pressing together a second portion of the same two film strips including part of the preselected area to seal the opening in the package and then removing said package from the machine.

35. A process for manufacturing packages of water-soluble film in a machine of the type which includes an applicator for

applying solvent activator to the film to make it adhesive which comprises the steps of pulling at least a first and a second strip of such film through the machine, applying a controlled amount of solvent in the form of discrete droplets in an area along the length at each side of at least one of said film strips and periodically applying a controlled amount of solvent activator in the form of discrete droplets in an area across the width of at least one of said film strips to tackify the surface and make it adhesive, moving said strips of film into sealing alignment and then pressing a portion of the adhesive area at both sides along the length of said strip against a second one of said strips without pressing the strips together across the entire width thereof to form a first longitudinal seal at both sides of said strips and thereafter pressing one of said adhesive areas positioned across said strip against the second one of said strips to form a second seal and a packaging envelope with an opening between said longitudinal seals, filling the package envelope through such opening, and then pressing a second one of said adhesive areas across said strip against the second one of said strips to seal the opening in the filled package and to form a second packaging envelope.

36. An apparatus for manufacturing packages made with water-soluble film which comprises, means for pulling at least one strip of such film to advance it through the apparatus, means for applying a controlled amount of solvent activator in the form of discrete droplets to the film in an area along the length of at least one side of said film and for applying a controlled amount of solvent activator in the form of discrete droplets periodically in an area across the width of at least one film strip to activate the surface and make it adhesive, means for moving said adhesive areas into sealing alignment with a portion of unactivated film, means for pressing the adhesive area along the length of at least one side of the film against the unactivated film to establish a first longitudinal seal without pressing the film together across the entire width thereof, means for thereafter pressing one of said adhesive areas across the width of the film against unactivated film to establish a second seal which forms a packaging envelope with an opening across a portion of the width at one end thereof and which at the same time completely encloses the preceding packaging envelope and means for filling the packaging envelope through said opening.

37. The apparatus specified in claim 36 which includes means for pulling at least two strips of film to advance them through the machine and in which said means for applying solvent activator is adapted to apply solvent activator to at least one strip of film in an area along the length at both sides of at least one film strip and in which the means for establishing the first longitudinal seal is adapted to press the adhesive area along both sides of the film against inactive film to establish a longitudinal seal at both sides of the packaging envelope.

38. A process for manufacturing packages of water-soluble film in a machine of the type which includes an applicator for applying solvent activator to the film to make it adhesive which comprises the steps of: applying tension to a first strip of such film and simultaneously applying tension to a second strip of such film to move said film strips through the machine, applying a controlled amount of solvent activator consisting of water and an additive to preselected areas of at least one of said film strips to activate and tackify the surface thereof before any part of the package is formed but insufficient to reduce the strength of the film below that needed to withstand the said tension forces applied to the film, moving said first and second strips of film into sealing alignment with each other by the continued application of tension solely to the said film strips, pressing a portion of said first and second strips of film together to form a seal between the two strips of film and a packaging envelope open at one end thereof, filling the package through the open end thereof, pressing a second portion of said film strips together to seal the open end of the package, and moving said package out of said machine by the continued application of tension solely to said film strips.

39. A process for manufacturing packages of water-soluble film in a machine of the type which includes an applicator for applying solvent activator to the film to make it adhesive which comprises the steps of: applying tension to a first strip of such film and simultaneously applying tension to a second strip of such film to move said film strips through the machine, applying a controlled amount of solvent activator in the form of discrete droplets to preselected areas of at least one of said film strips to activate and tackify the surface thereof before any part of the package is formed but insufficient to reduce the strength of the film below that needed to withstand the said tension forces applied to the film, moving said first and second strips of film into sealing alignment with each other by the continued application of tension solely to the said film strips, pressing a portion of said first and second strips of film together to form a seal between the two strips of film and a packaging envelope open at one end thereof, filling the package through the open end thereof, pressing a second portion of said film strips together to seal the open end of the package, and moving said package out of said machine by the continued application of tension solely to said film strips.

40. The process specified in claim 39 further comprising the step of applying between 30 and 230 discrete droplets per linear inch to said preselected areas of said film.