United States Patent [19]

Bridgeford et al.

[11] **3,922,398**

[45] **Nov. 25, 1975**

[54] **METHOD FOR FORMING FIBROUS SAUSAGE CASINGS**

[75] Inventors: **Douglas J. Bridgeford,** Champaign; **Frank M. McNeil,** Lombard, both of Ill.

[73] Assignee: **Tee-Pak, Inc.,** Chicago, Ill.

[22] Filed: **May 8, 1974**

[21] Appl. No.: **467,978**

[52] **U.S. Cl.** **427/259;** 53/12; 53/13; 53/28; 53/DIG. 1; 426/89; 426/105; 426/138; 427/282; 427/434

[51] **Int. Cl.²** **B44D 1/52**

[58] **Field of Search** ..... 117/5.5, 38, 94, 122 P, 117/113, 115; 426/89, 92, 105, 138, 140; 118/504, 505; 53/7, 12, 13, 28, DIG. 1; 427/259, 272, 282, 230, 434

[56] **References Cited**

UNITED STATES PATENTS

3,135,613	6/1964	Underwood	117/66 X
3,378,379	4/1968	Shiner et al.	117/95 X
3,433,663	3/1969	Underwood	117/62.1
3,482,491	12/1969	Gustafson	93/82
3,562,368	2/1971	Bridgeford	117/2 X
3,700,549	10/1972	Liss-Albin Croon et al.	162/158 X

Primary Examiner—Thomas J. Herbert, Jr.
Assistant Examiner—Bruce H. Hess
Attorney, Agent, or Firm—Neal J. Mosely; Russell L. Brewer

[57] **ABSTRACT**

This invention relates to an improvement in a process for producing fibrous (reinforced) artificial sausage casings. In the basic process, a porous web is formed into a tube, impregnated with polymeric dope in an impregnation zone vented for removal of accumulated fluids, coagulated, regenerated, and then inflated for drying. The improvement in this basic process resides in the method for venting fluids from the tubular fibrous casing and comprises masking a section of the porous web with a masking agent prior to impregnating said web in said impregnation zone thereby preventing this section from being impregnated with the polymeric dope and then removing said mask after the casing has passed through said impregnating zone. In a preferred embodiment after regeneration and prior to drying, the masked section is coated with a flexible, air impermeable film-forming material.

16 Claims, No Drawings

METHOD FOR FORMING FIBROUS SAUSAGE CASINGS

DESCRIPTION OF THE PRIOR ART

In the manufacture of reinforced, regenerated cellulose casings, paper web of relatively strong natural fibers such as manila hemp and flax have been coated and impregnated with a polymeric dope, e.g., viscose. Viscose is the name given to a solution of sodium cellulose xanthate dissolved in sodium hydroxide. The impregnated porous web then is passed through a coagulating bath and into a regeneration bath for regenerating the cellulose. During the coagulating and regenerating steps of the process, fluids in the form of liquids and gases accumulate inside the tubular casing. These fluids must be released periodically in order to maintain the casing at constant diameter and to permit drying of the casing. The casing after regeneration then is plasticized and dried. After drying, the casing is wound onto a reel and is referred to as reel stock.

In order to effect release of fluids from inside the tubular fibrous casing, the casings normally are punctured or perforated before they enter the coagulating tank. Usually perforation is done intermittently and typically a perforation in the casing is made every 20 – 40 minutes. These punctures generally are in the form of long slits, e.g., 2 – 12 inches in length. Thus, as the casing passes through the coagulating and regenerating baths, the fluids which have accumulated in the casing are released to the bath through the perforations.

In order to inflate the casing for drying, it has been customary to cut out that section of casing containing the puncture by cutting the casing transverse to the longitudinal axis and then joining the casing by inserting a hollow rubber coupling into the two ends of the casing. The ends of the casing are tied about the coupling so that the casing can be inflated with air for drying. After drying, the coupling is removed from the casing by cutting and the severed casing is spliced together. An integral piece is formed by butting the two ends of the casing together and joining with tape.

It has been recently disclosed that accumulated fluids in fibrous tubular sausage casings can be removed by introducing a plurality of small perforations (holes) into the casing and then sealing these holes by placing a patch of flexible material thereover and securing with a water activated adhesive. Examples of water activated adhesives for sealing the patch include alpha-cyanomethyl acrylate, finely divided carboxymethyl cellulose, sodium alginate, polyvinyl alcohol and cellulose xanthate.

There are several problems associated with the customary methods of venting fluids in the manufacture of fibrous sausage casings. One basic objection with casing having splices therein is that it resulted in a loss of casing. The spliced section, which included the two ends joined by tape, is discarded to scrap or sold to specialty meat processor operations which do not use automatic stuffing equipment. Another basic objection with spliced fibrous casing is the poor shirring characteristics of the casing. In shirring, the tape used for joining the casing often adhered to the shirring mandrel and caused a shirring "miss." Each "miss" resulted in downtime and required the shirring operators to remove the bad section of casing from the mandrel and re-thread the shirring machine. Another problem of fibrous casing spliced with tape is that it is difficult to

wind long sections on radial winding apparatus (as shown in U.S. Pat. No. 3,709,703). On winding, the casings are moistened and, of course, at each juncture the splice fails because of reduced adhesion of the tape.

SUMMARY OF THE INVENTION

This invention relates to an improvement in a basic process for forming reinforced regenerated cellulose sausage casings. The basic process comprises extruding a porous web through an annular die, impregnating the porous web with a polymeric dope in an impregnation zone, venting accumulated fluids from inside the casing, and inflating the casing for drying. The improvement constituting the basis of the invention resides in the providing of an improved venting means for removal of accumulated fluids. The improvement comprises: masking a section of the porous web with a masking agent prior to the step of impregnating the porous web with viscose in said impregnation zone and removing the mask after the masked section of the casing has passed through said impregnating zone. The masking of the porous web prevents that section from being impregnated with a polymeric dope and the demasking permits fluids to vent through the non-impregnated porous web in the coagulation and regeneration baths.

In a preferred embodiment of the invention, the demasked section of casing is coated with a flexible film-forming, substantially air impermeable material after the casing has passed through the regeneration zone and prior to drying. This subsequent coating of the masked section with a flexible air impermeable material permits the casing to be inflated with air for drying.

Advantages of this invention include: a method for removing fluids which accumulate in the casing during coagulating and regenerating of the cellulose; a method for removal of fluids which eliminates conventional perforating and subsequent patching or splicing of the casing; a method for producing casing which eliminates waste of casing due to the perforation of the casing; a method for producing artificial sausage casings which permits shirring of the casing without substantial danger of rupture or breaking; a method for producing casing which can be radial wound without failure; and a method which reduces the manpower needed to produce the casing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This process is particularly adapted for the production of reinforced, regenerated cellulose sausage casings. Reinforced, regenerated cellulose casings are prepared by impregnating a tubular porous web, usually manila hemp paper, with polymeric dopes, e.g., viscose, and then the polymer, i.e., cellulose, is subsequently regenerated. As stated previously, fluids in the form of liquids and gases accumulate inside the thus formed tubular casing and must be removed prior to drying. Liquids generally accumulate inside the casing because of osmotic pressure generated in the coagulating baths. Gases accumulate inside the casing in the regenerating cycle via the reaction between an acid and the xanthate group.

Any of the polymeric dopes employed in the manufacture of fibrous or reinforced sausage casings can be used in the process of this invention. These polymeric dopes are generally solutions or dispersions of a polymer in alkali, e.g., sodium hydroxide, although they can

be in other solvents. Typical dopes include: viscose, polyvinyl alcohol, cellulose ethers, e.g., ethyl cellulose, hydroxyethyl cellulose, and cellulose esters, e.g., cellulose proprionate, and cellulose nitrate. Commercial viscose is the dominant polymeric dope used for making fibrous casings and is preferred in the practice of this invention.

In practicing this invention, a section of the porous web is masked with a masking agent for preventing that section of casing from being impregnated with viscose. This masked section usually is in the form of a strip, e.g., from about 1 – 2 inches wide and from about 5 – 30 inches in length. The masking agent, of course, should be substantially impermeable to polymeric dope penetration. If the masking agent is not substantially impermeable to dope penetration, then carryover of the dope into the masked section results and prevents the venting of fluids which accumulate inside the tubular casing. Preferably, the masking agent should be one which can be easily applied to the porous web, be easily removed after the web has been impregnated without adversely affecting the integrity of the tubular casing, and sufficiently rigid enough to define a sharp boundary preventing feathering (non-uniform coating) when the masked section is subsequently coated with a film-forming material.

Examples of solid masking agents suitable for masking the porous web include: tape, fibrous paper, or polymeric films, e.g., polyethylene and polypropylene bonded to the porous web with tape, an adhesive, or viscous liquid, e.g., corn syrup or sugar solutions. All that is required in these instances is the adhesive medium provide sufficient strength to hold the masking agent to the porous web as it passes through the die and that the adhesive medium be non-detrimental to the coagulating bath. The solid masking agent can be removed manually from the bath.

Liquid masking agents can also be used for preventing impregnation of the porous web with the polymeric dope. Preferably the liquid masking agents should be soluble in the coagulating solution so that the masking agent can be leached from the web once the web is through the impregnation zone. Examples of liquid masking agents include: polyhydric alcohols, e.g., ethylene and propylene glycol, glycerol, sorbitol, mannitol, polyethylene glycol, etc., hot melt sugar and salt solutions which crystallize when cooled to impregnation zone temperatures, e.g., sucrose and corn syrup solutions (40 –80%) solids, sodium nitrate and sodium acetate. The salt solutions preferably should have a high solubility at elevated (80°C.) temperatures and low solubility at low 25°C. temperatures so that better coverage of the web can be obtained. These salts also should be non-toxic or detrimental to the baths.

Liquid masking agents can also be applied to the web and cooled until solid, e.g., ice. The solid can melt and be leached from the web. Water works well in these instances.

Masking of a section can also be accomplished by stopping the flow of viscose for a short period of time to provide a blank or bare section. Termination of the flow of viscose can be conveniently done during the formation of the seam or during the processing of the casing. For example, a spray of viscose may be stopped for about 1 or 2 seconds leaving a bare section through which accumulated fluids can be vented. Accordingly, a termination in the flow of viscose is contemplated as a masking agent.

Sometimes it is desirable to puncture the non-coated section of casing with a plurality of small needles, e.g., 10 – 50 mils in diameter to induce venting of gas from inside the casing. It has been found that it takes about 5 – 6 inches water to force gas through non-perforated fibrous paper whereas gas readily vents through perforated casing. These small perforations are sealed by the flexible film-forming material applied to the casing prior to drying. On the other hand, larger perforations as noted in U.S. Pat. No. 3,562,368 must be patched.

In carrying out the process for fibrous casing manufacture, the masking agent is applied to the porous web either before or after tube formation. Generally, the masking agent is applied to the tubular casing. Once the porous web is formed into a tube and a section of the tube has been masked, it is passed through an impregnation zone wherein the tube is coated with viscose. The polymer dope, e.g., viscose, penetrates into the porous web but fails to penetrate the masked section. After the tubular casing, including the masked section is passed through the impregnation zone, the masking agent is removed from the porous web so that the liquid and gaseous fluids can vent from the casing. Usually removal of the masking agent is done manually immediately after the impregnation zone or is effected by the action of coagulation and regeneration baths. As stated earlier, one of the advantages of using a water-soluble masking agent is that it is removed by the coagulating and regenerating baths and, therefore, eliminates the manpower required to remove the masking agent. This is one of the disadvantages with using tape as a masking agent even though tape is very effective for preventing penetration of the polymer dope into the porous web.

When the coagulating and regenerating cycles have been completed, and prior to the drying cycle, the uncoated or non-impregnated section must be coated with a flexible film-forming, air impermeable material so that the casing can be inflated with air and dried. In a preferred embodiment, the film-forming, air impermeable material should be sufficiently strong and flexible to permit the casing to be passed through the dryer, shirred, and stuffed with a sausage emulsion by the meat processor without rupturing or cracking. Further, the film-forming, air impermeable material should be non-tacky to the touch, substantially immediately after it is applied to the casing surface. If it is tacky, other portions of the casing may adhere to the coated section or the coating section may adhere to the processing apparatus, e.g., the dryer or to itself. The film-forming, air impermeable material should cure or set in a period of from about 5 – 60 seconds after it is applied to the casing so that the operator can attend other lines. Materials having longer residence or cure times can be employed, as noted in the examples, but they are usually not preferred for commercial facilities.

Examples of suitable, flexible, film-forming, air impermeable materials include: gelatin or gelatin crosslinked with a conventional crosslinking agent such as a dialdehyde, e.g., glutaraldehyde or glyoxal, plasticized alginates crosslinked with a polyvalent metal salt, e.g., calcium chloride; film-forming polymers, e.g., hot melts preferably having a melting point of 160°C. or less of polyethylene, polypropylene, and nylon granules, and aqueous dispersions, e.g., solutions or emulsions of polymeric film-forming materials such as solutions of hydroxymethylated nylon, low molecular weight polyamide fatty acids, and lower alkyl esters of

acrylic and methacrylic acid having from 1 – 6 carbon atoms. Other suitable materials include: alkali cellulose and starch xanthate; cellulose microspheres; and ground cellulose. Film-forming materials which have commercially desirable features include: methanol-water solutions of hydroxymethylated nylon and polyamide fatty acids, e.g., acids of dimerized vegetable oil acids. These set or gel within a few seconds and are highly reliable in patching operations.

The film-forming, air impermeable materials can be applied to the non-impregnated section of tubular casing by conventional means. For example, liquid solutions of polyhydric alcohols and polymeric dispersions can be applied by brushing or spraying the dispersions over the surface of the tubular casing. Hot melt, polymeric materials can be applied by heating the polymeric material to a sufficient temperature for converting it to a liquid and then applying the liquid to the non-impregnated section and then cooling to permit solidification. Care is taken in the coating of the previously masked or non-impregnated section to produce a thin film of materials of uniform thickness. Generally, the film thickness is from about 1 – 3 mils but the thickness can be regulated as desired.

The following examples are provided to illustrate preferred embodiments of the invention and are not intended to restrict the scope thereof. All percentages are expressed as weight percentages unless otherwise specified.

EXAMPLE 1

In the manufacture of reinforced, regenerated cellulose sausage (fibrous) casings, a porous web of manila hemp paper is formed into a cylindrical tube. A commercially available masking tape sold under the "Scotch" Trademark by 3M Company of about 1 inch in width and 12 inches in length is applied to the external wall of the tube parallel to the longitudinal axis. Sometimes the tape is desensitized by coating the adhesive surface with cellulose spheres so that the tape can be removed from the casing without destruction. The resulting masked casing, then, is passed through a die and impregnated with viscose. The viscose penetrates the porous structure of the hemp paper but does not penetrate the section masked with tape. After the porous web containing the masked section of paper has passed through the impregnation zone and prior to immersion of the section in the coagulating tank, the tape is removed. Removal of the tape is necessary to expose the uncoated or non-impregnated section of the casing to the coagulating and regenerating baths for effecting venting of fluids in the form of liquids and gases from inside the casing. Once the tubular casing has passed through the coagulating and regenerating baths, the previously masked but now uncoated or non-impregnated section is coated with a flexible, air impermeable film-forming material so that the casing can be inflated with air for drying.

A first coating of an acidified solution of glutaraldehyde in water having a pH of about 2 is applied over the uncoated section. Then a 4% solution of gelatin (Bloom 275) in water is brushed over the glutaraldehyde coated area and heated with a hot air (35°C.) blower. Crosslinking of the gelatin occurs in about 6 seconds thereby forming a flexible, air impermeable film. The resulting film has a thickness of about 1 – 2 mils. The casing can be inflated with air and dried.

After drying, the casing can be wound onto a reel without cracking; the casing can be shirred or radial wound without the normal occurrence of breakage normally associated with spliced fibrous casing; and can be stuffed with a sausage emulsion for the manaufacture of sausages. Additionally, this method eliminates loss of casing due to the customary cutting and splicing.

EXAMPLE 2

A fibrous casing is made in accordance with Example 1 except that a 20% solution of hydroxymethylated nylon, sold under the Trademark of Zytel 61 by DuPont, in methanol and water is brushed over the non-impregnated section instead of gelatin. The nylon coated section gels within about 5 seconds due to the presence of water and glycerin in the casing. The casing is permitted to dry for about 3 minutes. This casing is non-tacky to the touch, can be pressurized before passing to the dryer to 8 – 9 psi without danger of rupture, and processes nicely through the dryer and shirring operations. If the 20% solution of Zytel 61 in methanol and water is applied to a non-impregnated section and force dried using a heat gun (80°C.), pinholes generally result. These pinholes prevent the casing from being inflated with air. Therefore, it is preferred to let the casing dry at room temperature for a couple of minutes. However, because gelation takes place so rapidly, the operator can leave the casing and attend to other lines.

EXAMPLE 3

A fibrous casing is made in accordance with Example 1 except that a hot melt is applied to the non-impregnated section of casing instead of gelatin. A hot melt is made by melting hydroxymethylated nylon granules and the melt brushed over the surface of the casing. The hot melt then is cooled to permit film formation. It is noted that better adhesion results when the nylon melt is applied to fibrous paper which is dry as opposed to wet fibrous paper. In both instances, the casing could be inflated with air to pressures of 8 – 9 psi and processed through shirring operation without substantial danger of rupture.

EXAMPLE 4

A fibrous casing is made in accordance with the method of Example 3 except that a 50% dispersion of polyethylene granules in water is used in place of the hydroxymethylated nylon granules. The dispersion when dried results in a strong, flexible, white adherent coat and is capable of withstanding inflation pressures of 10 psi. The casing can be wound onto a reel and processed on conventional shirring machines.

EXAMPLE 5

A fibrous casing is made in accordance with Example 1 except that an aqueous emulsion of a conventional self-cross-linking acrylic ester is used as a film-forming material in place of gelatin. The emulsion is brushed over the non-impregnated section of the casing and cured. Curing takes place in about 30 seconds when the film of 1 – 3 mils is heated with a hot air (40°C.) blower. It is noticed that the acrylic latex is somewhat soft and tacky but it is sufficiently acceptable for permitting the casing to be inflated and passed through the dryer. The casing can also be wound onto a reel and shirred without danger of breakage.

EXAMPLE 6

A fibrous casing is made in accordance with Example 1 except that the masking agent is 40% solution of corn syrup solids in water. The solution of corn syrup is brushed over a section of about 1 – 2 inches in width and 10 – 12 inches in length. The corn syrup solution because of its water-solubility is leached from the casing as it passes through the coagulating and regenerating baths. The leaching of the corn syrup from the tubular casing in these baths leaves an uncoated or non-impregnated section through which fluids inside the casing can be vented.

After the casing is passed through the regenerating bath, the non-impregnated section or previously masked section is coated with a condensation polymer made from a dimerized vegetable oil acid and ethylene diamine. The condensation polymer is sold under the Trademark Versamid 950 by General Mills Corp. The dimerized vegetable oil polyamide sets in about 30 seconds and the casing then can be inflated with air for drying.

The casing processes through the dryer and shirring operation without problem. The polyamide, film-forming material has excellent strength and flexibility for preparing reinforced fibrous casing.

EXAMPLE 7

A fibrous casing is prepared in exactly the same manner as Example 6 except that in place of the dimerized vegetable oil polyamide film former, the demasked section is first coated with a solution of 1 ½% sodium alginate in water and then coated with an 85 : 15 mixture of water and tetrahydrofuran containing 5% sodium alginate. The sodium alginate is crosslinked by brushing a solution of 10% calcium chloride in water over the area to form the film-forming, air impermeable layer. The resultant film is strong, shiny, and non-tacky. Wet films resist inflation pressures of from 5 – 7 psi without delamination.

EXAMPLE 8

A fibrous casing is made in accordance with Example 7 except that in place of the sodium alginate, a 2.5% solution of cellulose microspheres having a DP of 300 in 85% phosphoric acid-water is applied to the non-impregnated section. The cellulose coated section then is immersed in water (26°C.) for about 30 – 60 seconds to precipitate the cellulose.

The resulting film is firm, non-tacky, and resists inflation pressures of 5 psi. The film processes nicely through the dryer but it is noted that cracking sometimes occurs in the shirring operation.

EXAMPLE 9

A fibrous casing is made in accordance with Example 8 except that pure glycerol is employed as a masking agent in place of the corn syrup solution. The glycerol is applied by brushing and then leveled with a 30 mil draw-down bar.

The glycerol dissolves readily in the coagulating solution of sulfuric acid and sodium sulfate at a rapid rate for producing a good, well defined window through which fluids and gases can vent.

We claim:

1. In a method for forming a tubular fibrous sausage casing which includes the steps of extruding a porous web as a tube, impregnating said porous web with a polymeric dope in an impregnation zone, coagulating and regenerating the polymer, venting fluids which accumulate inside said tubular casing during coagulation and regeneration, and then drying; the improvement for venting fluids from said tubular casing which comprises:

masking a section of said porous web with a masking agent prior to the step of impregnating said web with polymeric dope thereby preventing said section from becoming impregnated; and, then,

removing said masking agent thereby leaving an uncoated section after said casing has passed through said impregnation zone,

coating said uncoated section of said casing with a flexible, film-forming, air-impermeable material after said casing has passed through the regenerating zone and prior to drying.

2. The method of claim **1** wherein said polymeric dope is viscose.

3. The method of claim **2** wherein said masking agent is removed prior to the steps of coagulating and regenerating.

4. The method of claim **3** wherein said masking agent is tape.

5. The method of claim **2** wherein said masking agent is selected from the group consisting of liquid polyhydric alcohols and salt solutions.

6. The method of claim **5** wherein said masking agent is a polyhydric alcohol having from 2 – 6 carbon atoms.

7. The method of claim **6** wherein said polyhydric alcohol is glycerol.

8. The method of claim **5** wherein said film-forming, air impermeable material is a polymeric film-forming material.

9. The method of claim **8** wherein said polymeric film-forming materials are thermoplastic polymer granules.

10. The method of claim **9** wherein said film-forming material is applied by melting a polyolefin or polyamide polymeric film-forming material, applying this melt to the uncoated section of tubular casing, and then solidifying said melt.

11. The method of claim **10** wherein said polymeric film-forming material is granulated nylon.

12. The method of claim **8** wherein said film-forming material is an emulsion of a lower alkyl ester of acrylic or methacrylic acid.

13. The method of claim **12** wherein said acrylic emulsion is of a self-crosslinking acrylic ester.

14. The method of claim **8** wherein said polymeric film-forming material is a solution of a polyamide resin.

15. The method of claim **14** wherein said polyamide resin is a dimerized vegetable oil fatty acid amide.

16. The method of claim **14** wherein said polyamide resin is a hydroxylmethylated nylon.

* * * * *