# United States Patent [19]

**Kindl et al.**

[11] **3,896,764**

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[54] **EXTRUSION APPARATUS FOR COATING BOTH SURFACES OF TUBULAR MATERIAL**


[75] Inventors: **Erwin Kindl**, Wiesbaden-Blebrich; **Günter Gerick**, Oberursol, both of Germany

[73] Assignee: **Hoechst Aktiengesellschaft**, Germany



[22] Filed: **July 18, 1973**

[21] Appl. No.: **380,274**

**Related U.S. Application Data**

[60] Continuation of Ser. No. 193,524, Oct. 28, 1971, abandoned, which is a division of Ser. No. 100,916, Dec. 23, 1970, Pat. No. 3,709,720.

[30] **Foreign Application Priority Data**

Dec. 27, 1969 Germany ..... 1965130

[52] **U.S. Cl.** ..... **118/408;** 118/411; 425/113

[51] **Int. Cl.** ..... **B05c 3/12**

[58] **Field of Search** ..... 118/DIG. 10, DIG. 11, 411, 118/408, 404, 405; 117/94, 95; 164/86, 275; 425/92, 413, 414



[56] **References Cited**

FOREIGN PATENTS OR APPLICATIONS

| | | | |
|---|---|---|---|
| 536,602 | 1/1957 | Canada | 118/DIG. 10 |
| 601,670 | 2/1960 | Italy | 118/DIG. 11 |



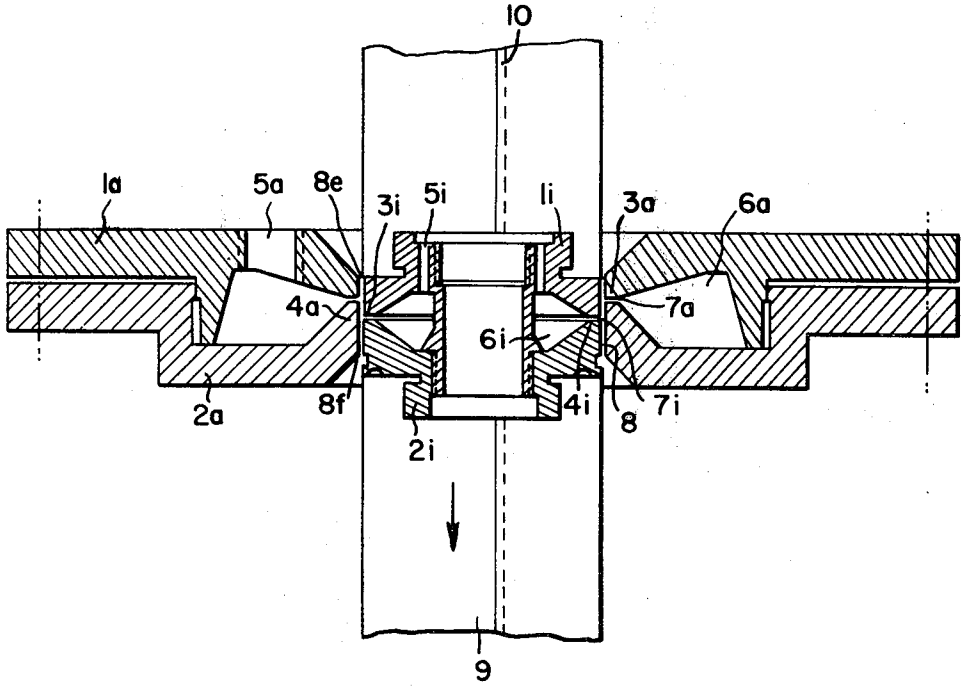
*Primary Examiner*—Morris Kaplan
*Attorney, Agent, or Firm*—James E. Bryan

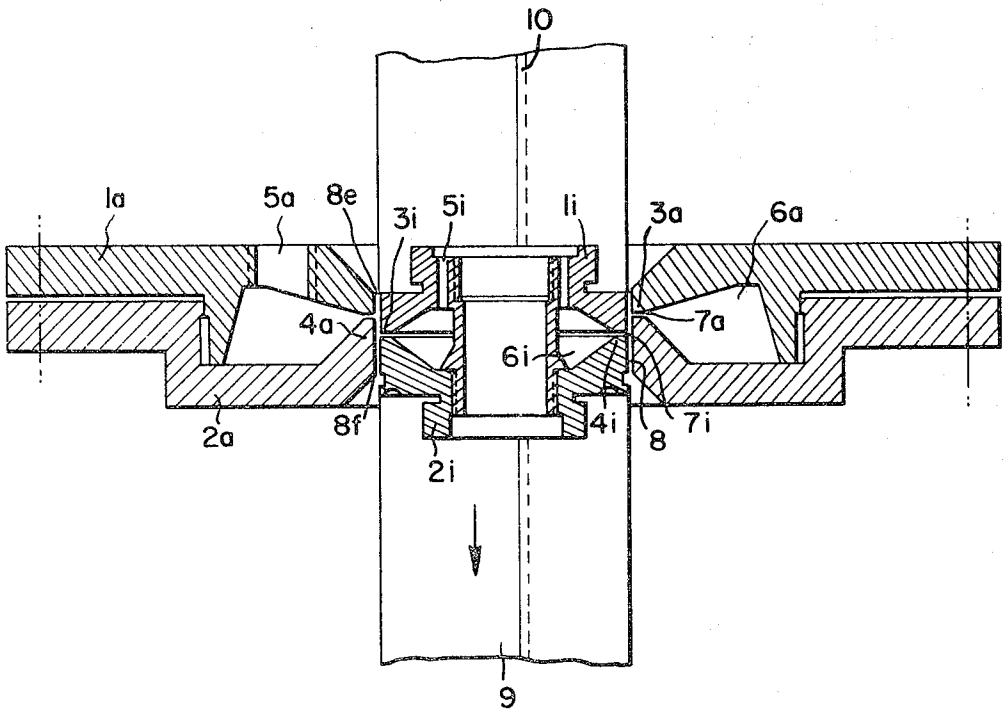


[57] **ABSTRACT**

This disclosure relates to a process and apparatus for the continuous coating of a tube of fiber material with viscose, the process comprising conveying the tube so that its wall traverses a cylindrical zone of a width of 0.3 to 1.0 mm, defined by external and internal elements, and in its progress through said zone is coated with viscose first on the exterior and then on the interior thereof.


**4 Claims, 1 Drawing Figure**




10
1a
5a
8e
3i
5i
1i
3a
6a
4a
7a
6i
2a
8f
4i
8
7i
2i
9

# EXTRUSION APPARATUS FOR COATING BOTH SURFACES OF TUBULAR MATERIAL

This is a continuation, of application Ser. No. 193,524, filed Oct. 28, 1971, now abandoned and which was in turn a division of application Ser. No. 100,916, filed Dec. 23, 1970, now U.S. Pat. No. 3,709,720.

This invention relates to apparatus for coating a tube of fiber material with viscose by extrusion.

Fiber-reinforced tubes of regenerated cellulose are known which consist of a tube of fiber material coated on the outside and inside with a layer of regenerated cellulose and which tube is filled more or less completely with regenerated cellulose located between the fibers. The tube of fiber material is formed from a web of fiber fleece by bonding together the overlapped edges of the web. The seam is preferably bonded with viscose. The application of the two coatings of viscose is carried out with the aid of annular dies in conjunction with a backing element which supports the tube when the viscose is forced onto it from the annular dies. When applying the outer coating, an annular die is employed which forces the viscose inwards and which surrounds the backing element, whereas when the inner coating is applied an annular die is used which forces the viscose outwards and is surrounded by an annular backing element. In U.S. Pat. Nos. 2,105,273 and 2,144,900 it is stated that the apparatus described therein can be used for coating both sides of a tube. In one of the above-mentioned patent specifications an annular die is described suitable for applying the outer coating of viscose, and the tube of fiber material, directly after the application of the viscose, is passed through a cylindrical passage between the annular die and a backing element. The tube, provided with the two coatings of viscose, is then subjected to various further treatments having, among others, the purposes of coagulating the viscose and regenerating it to form cellulose, washing the tube, incorporating a plasticizer into it, and drying it.

In producing fiber-reinforced cellulose tubes by applying a coating of viscose on only one side of the tube, it has been found expedient only to pass the tube into the setting bath, in which the viscose is coagulated and regenerated partially or completely to form cellulose, after the viscose has fully penetrated the tube. If coagulation takes place before the tube is fully penetrated by the viscose, then there is finally obtained a fiber-reinforced cellulose tube of lower strength and poorer transparency than is the case when coagulation and regeneration are carried out after complete saturation of the tube of fiber material by the viscose.

The penetration of the viscose into the tube of fiber material requires a certain time, as does the coagulation of the viscose in the setting bath. Since, during the continuous production of fiber-reinforced tubes of regenerated cellulose by the above-described method, the coating of the tube with viscose and the coagulation of the viscose coatings must be carried out while the tube is moving downwards, without being laid flat, the height of the plant used increases with the required production rate and the length of time needed for the penetration of the viscose into the tube and for coagulation of the viscose.

The present invention provides an apparatus for the continuous coating of a tube of fiber material with viscose, wherein the tube is so conveyed that its wall traverses a cylindrical passage of a width of 0.3 to 1.0 mm, defined by external and internal elements, and in its progress through this passage is coated with viscose first on the exterior and then on the interior. This process reduces the amount of space and time required for the coating of a tube of fiber material on both sides with viscose.



The invention further provides an apparatus inlcuding as an external element an annular slot die with the slot directed internally towards the passage and as an internal element an annular slot die with the slot directed externally towards the passage, the arrangement being such that the passage has the indicated width and external and internal coating of the tube can be carried out in the indicated sequence. The distance from the exit opening of the passage through which the tube passes at which the viscose is applied to the inside of the tube depends upon the selected width of the passage through which the tube passes. The distance is between 1 and 50 mm and must be the greater the greater the width of the passage. The thinner the fiber fleece of which the tube is made, the greater, as a rule, the width within the stated limits of 0.3 and 1.0 mm. Advantageously, the following relationships are observed between the width *w* of the passage through which the tube passes and the distance *a* between the slot in the inner die and the exit opening (values in mm):

| w | 0.3 | 0.4 | 0.6 | 0.8 | 1.0 |
|---|---|---|---|---|---|
| a | 1–5 | 1–10 | 2–15 | 3–30 | 5–50 |

The distance *a* is measured from the exit opening to the nearest edge of the annular slot in the inner die. Intermediate values between those shown in the above table of relationships can, of course, be used.

The same limits apply to the distance over which the tube is passed between the application of the viscose to its outside and the application to its inside. Here, if required, relatively short distances can be used. The distance over which the tube is passed in the passage prior to the application of viscose to the outside of the tube is such that no viscose escapes at the entry opening of the passage through which the tube passes. For this purpose, a distance of travel of at least 2 mm is generally necessary. Advantageously, this distance is kept within the above-state limits for the distance *a*.

In the production of fiber-reinforced synthetic sausage casings made of regenerated cellulose for which the method is primarily intended, use is made in most cases of fiber fleeces having a thickness of 0.06 to 0.12 mm. The above-mentioned and following details relating to dimensions such as length and width of the passage through which the tube passes and the distances of the slots in the annular dies from one another or from the entry or exit openings, respectively, of the passage through which the tube passes apply in the case of fiber fleeces of the above thicknesses.

In the process utilizing the apparatus of the invention the viscose is expediently applied to the inside of the tube of fiber material at the latest one second after the application of viscose to the outside of the tube, and advantageously the two applications of viscose take place with an interval of 0.003 to 0.3 second. The rate at which the operation is carried out, i.e. the rate of travel of the tube of fiber material, can be 20 meters/min. or more.

Generally, the passage through which the tube passes is of the same width from the entry opening to the exit opening. The width may vary within the length of the passage but preferably any variation is at most 0.2 mm. However, the approach to the entry opening and the departure path from the exit opening may, if desired, be convergent and divergent, respectively.

The apparatus of the invention is further illustrated diagrammatically by way of example in the accompanying drawing, the single FIGURE of which is a cross-section of the apparatus.

Referring to the drawing, the apparatus consists of an outer annular die and an inner annular die located therein, each of the two dies consisting of two parts, i.e. an upper part 1*a* and 1*i* respectively and a lower part 2*a* and 2*i* respectively.

The outer annular die 1*a*, 2*a* has a central cylindrical bore, the wall of which is formed by an upper lip 3*a* and a lower lip 4*a* of the die. The two component parts 1*a* and 2*a* of the die form an annular chamber 6*a* into which leads a feed pipe 5*a*. The annular chamber 6*a* is for receiving viscose which is forced into it through the feed pipe 5*a*. The viscose passes from the annular chamber 6*a* into an annular slot 7*a* which enters the cylindrical bore between the two lips 3*a* and 4*a* of the die.

The inner annular die 1*i*, 2*i* is located in the central bore of the outer annular die 1*a*, 2*a*. The outer wall of this inner die are formed by an upper lip 3*i* and a lower lip 4*i* of the inner die. The two component parts 1*i* and 2*i* likewise form an annular chamber 6*i*.

A feed pipe 5*i* enters this chamber. The annular chamber 6*i* is also used for receiving viscose which is forced into it through the feed pipe 5*i*. The viscose passes from the annular chamber 6*i* into an annular slot 7*i* which is formed between the lips 3*i* and 4*i* of the die and extends through the outer wall of the annular die 1*i*, 2*i*.

Between the outer die lips 3*a* and 4*a* on the one hand and the inner die lips 3*i* and 4*i* on the other there is a cylindrical annular passage 8 by which the tube passes through the apparatus. Its entry opening is designated by the reference symbol 8*e*, and its exit opening by 8*f*. The upper lip 3*i* of the inner annular die constitutes a backing element for the outer annular die 1*a*, 2*a*, and the lower lip 4*a* of the outer annular die 1*a*, 2*a* at the same time constitutes a backing element for the inner annular die 1*i*, 2*i*.

The two annular dies 1*a*, 2*a* and 1*i*, 2*i* are secured to a common frame in such a manner that they can be lined up coaxially with one another. The frame, the means for securing the two annular dies to it and the centering device are of known type and are not illustrated in the drawing.

In the drawing, the tube of fiber material that is to be coated is designated by the numeral 9, and its overlapped seam by the numeral 10.

The values *a* and *w* referred to above can be easily related to the accompanying drawing. Preferably, the distances between the entry opening of the passage for the tube and the annular slot of the external die and between the annular slot of the internal die and the exit opening of the passage for the tube are at least 2 mm and at least three times the width of the passage. They are preferably 3 to 15 mm and the width of the passage through which the tube passes is preferably 0.4 to 0.8 mm. Preferably, none of the three distances referred to above is greater than 50 mm. Greater distances would not bring about any additional advantages in the invention, but would cause the disadvantage that more material would be used for constructing the apparatus and the apparatus would become unnecessarily long.

For widths *w* other than those given it is preferable to use corresponding intermediate values for *a*, as indicated. The following relationship appears to apply, with good approximation to values obtained in practice, for the preferable minimum value of the distance *a* in relation to the width *w* (both measure in mm):

$$a_{min} = 5 \times w^2,$$

a minimum value of 1 being used, however, if this equation results in a smaller distance. The following relationship seems to apply, with good approximation to values obtained in practice, for the preferred maximum value of the distance:

$$a_{max} = 50 \times w^2.$$

The annular slots in the two annular dies usually have a width of less than 1 mm, and their length, in the radial direction, is usually only a few millimeters, i.e. 2 to 3 mm. However, neither the width nor the length of the annular slots 7*a* and 7*i* appears to have an appreciable effect upon the maximum rate at which the tube of fiber material can be coated with viscose, without failure of the viscose to completely saturate the tube or other undesirable effects occurring during the production of a fiber-reinforced cellulose tube. The amount of viscose per unit area applied to the tube of fiber material depends upon the quantity of viscose which is forced through the annular slots (7*a* and 7*i*) of the two dies during unit time, the rate of travel of the tube through the apparatus being the same. The total quantity of viscose applied can be distributed in widely varying proportions over the outside and inside of the tube of fiber material.

The annular slots in the two dies are preferably directed perpendicularly to the passage through which the tube passes, but can, however, also extend towards it at a downwardly inclined angle.

The apparatus of the invention is suitable for coating with viscose both sides of tubes of fiber material which are made from fiber fleeces having a thickness of approximately 0.06 to 0.12 mm. Tubes of fiber material having diameters of 30 mm or more can be coated. There appears to be no upper limit as regards diameter, since tubes of fiber material of relatively large diameter — up to 160 mm — have been successfully coated using the apparatus of the invention.

The method and apparatus of the invention enable viscose to be applied successively to the two sides of a tube of fiber material in a relatively short apparatus. The method and apparatus also offer the advantage that the viscose applied to the tube of fiber material rapidly penetrates into the tube. Thus, with a prescribed height of coating apparatus, it is possible to carry out two-sided coating more rapidly than previously, since the tube does not travel any great distance between the points at which the two layers of viscose are applied, and after leaving the apparatus to the point at which the viscose has fully penetrated the tube, the latter has to travel through the air over only a relatively short distance, so that the coagulating bath for the viscose can be made correspondingly deeper and the tube can be passed through it more rapidly. Conversely, it becomes possible to achieve a prescribed operating

rate with coating equipment, the height of which is less than heretofore. The method and the apparatus also offer the advantage that good results are obtained even when no separate step in the method is used for bonding the overlapping edges of the fiber fleece, the bonding of the overlapped portions instead taking place incidentally as a result of the external and internal coating of the tube of fiber material with viscose. The method is preferably performed in this manner, that is, without a separate operation for bonding the overlapped seam.

The following Examples further illustrate the invention:

## EXAMPLE 1

For producing a fiber-reinforced cellulose casing coated on both sides with cellulose, use was made of apparatus having the following dimensions:

| Inner die: | |
|---|---|
| Outside diameter measured at the lips of the die | 61.80 mm |
| Thickness of upper lip | 10.0 mm |
| Thickness of lower lip | 9.0 mm |
| Width of annular slot | 0.30 mm |
| Length of annular slot (radial) | 2.0 mm |
| Outer die: | |
| Inside diameter, measured at the lips of the die | 63.20 mm |
| Thickness of upper lip | 4.0 mm |
| Thickness of lower lip | 15.0 mm |
| Width of annular slot | 0.30 mm |
| Length of annular slot (radial) | 2.0 mm |
| Width of passage through which tube passes | 0.70 mm |
| Length of passage through which tube passes | 19.3 mm |

The annular slots in both dies were perpendicular to the passage through which the tube passes.

The surface of the coagulating bath was at a distance of 50 cm from the apparatus (travel through air). As a result of this short distance of travel through the air, which was determined to enable the apparatus to be operated in an improved manner, it was possible, in the same space as usual, to employ a 3-meter high coagulating tank instead of the 2-meter high tank previously used when applying a viscose coating on one side only of the tube. The distance of travel of the fiber fleece coated on both sides with viscose, from the point of entry into the coagulating bath to a lower guide roller (where the tube is flattened) was 2.60 meters.

The coagulating bath contained 20 g/l (gram per liter) of sulfuric acid and 150 g/l of ammonium sulfate. The fiber fleece was a standard commercial product as used in the manufacture of casings of fiber material and had a weight of 21 g per square meter, a thickness of 0.09 mm and a width of 204 mm. Bonding of the overlapping strip of fleece with viscose was not carried out as a separate step since this was accomplished incidentally by the viscose penetrating the fleece from the outward and inward directions.

Under the conditions described above, and at a speed of passage of 22 m/min (meters per minute), a fiber casing (synthetic cellulose casing with a fiber fleece base) of excellent appearance and very great strength was obtained. Furthermore, by using the apparatus described and by varying the quantities of viscose fed to the two annular nozzles, it was possible to effect a wide variation of the amount of viscose applied externally and internally. For example, a fiber casing having a weight per square meter of 95 g was produced, on which 50 per cent of the viscose was applied from the inside and 50 per cent from the outside.

## EXAMPLE 2

For producing a fiber-reinforced cellulose casing coated on both sides, use was made of apparatus having the following dimensions:

| Inner die: | |
|---|---|
| Outside diameter measured at the lips of the die | 61.80 mm |
| Thickness of upper lip | 12.0 mm |
| Thickness of lower lip | 6.0 mm |
| Width of annular slot | 0.40 mm |
| Length of annular slot (radial) | 3.0 mm |
| Outer die: | |
| Inside diameter, measured at lips of the die | 63.30 mm |
| Thickness of upper lip | 6.0 mm |
| Thickness of lower lip | 12.0 mm |
| Width of annular slot | 0.40 mm |
| Length of annular slot (radial) | 3.0 mm |
| Width of passage through which tube passes | 0.75 mm |
| Length of passage through which tube passes | 18.4 mm |
| The annular slots in both dies were perpendicular to the passage through which the tube passes. | |

The annular slots in both dies were perpendicular to the passage through which the tube passes.

The distance between the apparatus and the surface of the coagulating bath was 50 cm, and the distance from the surface of this bath to a lower guide roller (where the tube is flattened) was 2.60 m.

The coagulating bath contained 15 g/l of sulfuric acid and 130 g/l of ammonium sulfate. The fiber fleece had a weight per square meter of 17 g, a thickness of 0.07 mm and a width of 204 mm. 70 per cent of the viscose was applied on the outside and 30 per cent on the inside. At a speed of passage of 20 m/min. a very transparent, parchment-like fiber casing of excellent strength was obtained.

In the above Examples, the time required for the viscose to penetrate into the fiber fleece was 1.5 sec. This time could be further reduced without adversely affecting the quality of the product.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. An apparatus for use in the continuous coating of a tube of fiber material with viscose which comprises a cylindrical passage having a width of about 0.3 to 1.0 mm, first annular slot die means having the slot thereof directed inwardly toward said cylindrical passage and in open communication therewith, second annular slot die means having the slot thereof directed outwardly toward said cylindrical passage and in open communication therewith, said first and second slot die means being offset from one another along said cylindrical passage such that a tube of fiber material conveyed through said cylindrical passage is coated with viscose, first on the exterior thereof and then on the interior thereof, first viscose feed means in open communication with said first slot die means and second viscose feed means in open communication with said second slot die means, the distance between the first and the second slot die means, the distance of said first slot die means from the entry opening of the cylindrical pas-

sage for the tube and the distance of said second slot die means from the exit opening of said cylindrical passage for said tube being not more than 50 mm.

2. An apparatus as claimed in claim 1 in which the distance between the entry opening of the cylindrical passage for the tube and the first slot die means and the distance between the exit opening of the cylindrical passage for said tube and the second slot die means are at least 2 mm and at least three times the width of said cylindrical passage.

3. An apparatus as claimed in claim 2 in which the distance of the first slot die means from the entry opening of the cylindrical passage for the tube and the distance of the second slot die means from the exit opening of said cylindrical passage for said tube are at least 2 mm, but not less than 5 $w^2$ and not more than 50 $w^2$, where w is the numerical value of the width of said cylindrical passage in millimeters.

4. An apparatus as claimed in claim 1 in which the distance of the first slot die means from the entry opening of the cylindrical passage for the tube and the distance of the second slot die means from the exit opening of said cylindrical passage are 3 to 15 mm and the width of said cylindrical passage is 0.4 to 0.8 mm.

* * * * *

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

PATENT NO. : 3,896,764

DATED : July 29, 1975

INVENTOR(S) : Erwin Kindl and Günter Gerigk

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Item [75] , line 2 thereof, "Gerick" should read - - - Gerigk - - -.

Column 2, lines 8 and 9, "inlcuding" should read - - - including - - -. Line 47, "above-state" should read - - - above-stated - - -.

Column 3, line 27, "wall" should read - - - walls - - -. Line 48, "aecured" should read - - - secured - - -.

Column 4, line 10, "measure" should read - - - measured - - -. Line 61, after "apparatus" insert - - - and - - -.

Column 6, delete lines 22 through 24.

Signed and Sealed this

*ninth* Day of *December 1975*

[SEAL]

*Attest:*

**RUTH C. MASON**
*Attesting Officer*

**C. MARSHALL DANN**
*Commissioner of Patents and Trademarks*