June 9, 1936. J. VOSS ET AL 2,043,455

EXTRUSION APPARATUS

Filed June 27, 1934

Fig. 1.

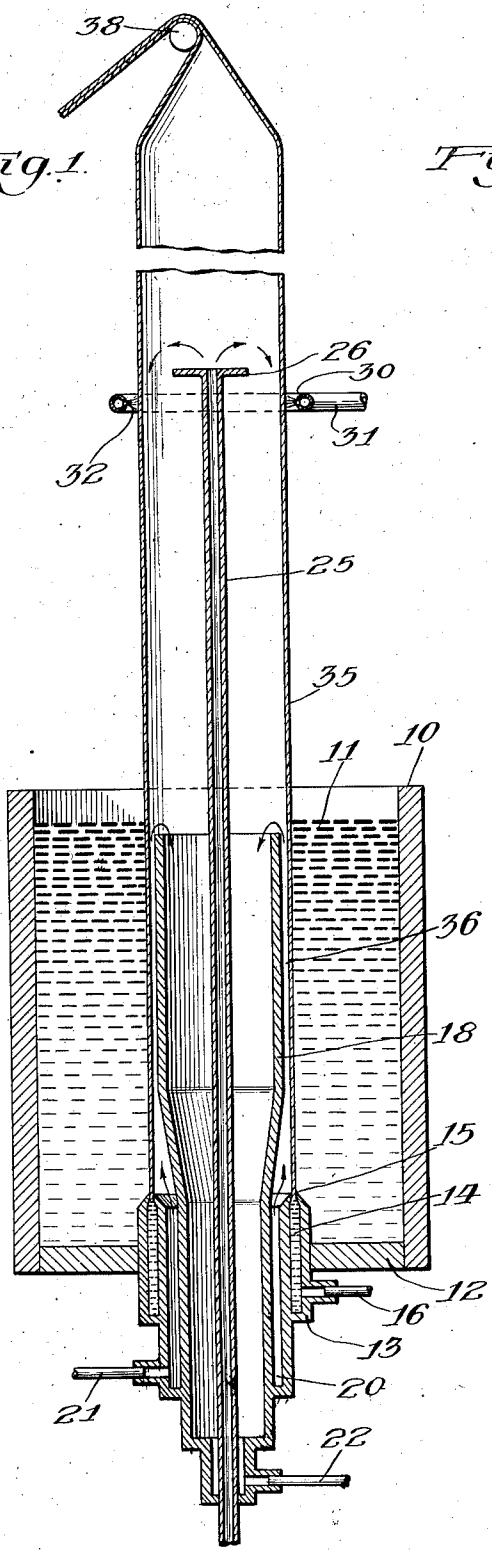
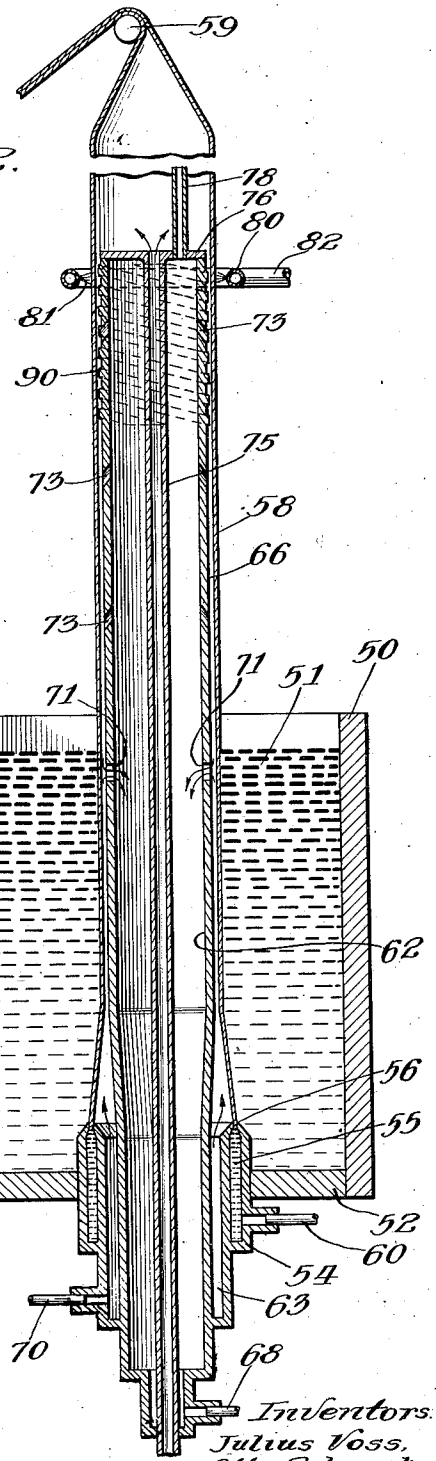


Fig. 2.



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Patented June 9, 1936

2,043,455

UNITED STATES PATENT OFFICE

2,043,455

EXTRUSION APPARATUS

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Application June 27, 1934, Serial No. 732,680
In Germany October 4, 1933

19 Claims. (Cl. 18—15)

The invention relates to extrusion apparatus and more particularly to apparatus for extruding viscose, or other compounds, to form seamless tubing.

It has been the practice heretofore to extrude viscose upwardly through an annular orifice of an extrusion nozzle into a bath which precipitates or coagulates the viscose to form seamless cellulose tubing. Usually, the tubing being formed above the annular orifice is drawn over a hollow core and some of the precipitating or coagulating bath is introduced into the space between the tube and the core. With this arrangement, both the inner and outer surfaces of the cellulose tube are subjected to the precipitating or coagulating fluid as the tube leaves the annular orifice. As it is preferable to have the extrusion nozzle within the reach of the operator during the extrusion operation, the depth of the precipitating or coagulating bath is necessarily limited. Usually, the cellulose tubing is completely or nearly completely precipitated or coagulated in the bath into which it is extruded. With the depth of the bath limited as described above, the speed of extrusion is relatively slow in order to obtain cellulose tubing which has a wall of sufficient strength.

In apparatus embodying the present invention, cellulose tubing having walls of sufficient strength may be produced while the viscose is extruded at a relatively high speed. In the improved apparatus, the core within the cellulose tubing preferably extends a considerable distance above the precipitating or coagulating bath and the inner surface of the tubing is subjected to a precipitating or coagulating fluid which preferably issues from the upper end of the core and gravitates downwardly between the core and the inner surface of the tubing. Precipitating or coagulating fluid is also sprayed, preferably, against the outer surface of the tubing some distance above the bath so that it gravitates downwardly along the outer surface of the tubing to the bath. The tubing thus formed of this regenerated viscose is then led over a roller and preferably passes through additional baths. The other baths may include regenerating and washing baths as well as a bath for treating the tubing with a softening agent such as glycerine. The distance from the surface of the extrusion bath to the first roller over which the tubing passes should be at least half as great as the depth of the bath but preferably it should be several times as great.

The tubing may be produced from various compounds such as, for instance, viscose, copper oxide ammonia cellulose solutions, cellulose ester solutions, or the like. Any suitable precipitating or coagulating baths may be employed.

A particular advantage of the improved apparatus is that the cellulose tubing is treated with fresh precipitating or coagulating fluid when it leaves the extrusion apparatus as well as when it first enters the precipitating or coagulating bath, both the inner and outer surfaces of the cellulose tubing being treated in this manner.

Another advantage of the improved apparatus is that the precipitating or coagulating fluid with which the tubing is treated after it leaves the precipitating or coagulating bath may be of a different composition than the initial precipitating or coagulating bath into which the tubing is extruded from the extrusion nozzle.

Other advantages will become apparent as the following detailed description progresses, reference being had to the accompanying drawing, in which—

Fig. 1 is a vertical central section taken through apparatus which embodies the invention and is adapted to form seamless cellulose tubing, and

Fig. 2 is a vertical central section taken through apparatus which embodies another form of the invention and is adapted to form seamless cellulose tubing.

Referring for the present to Fig. 1 which illustrates a preferred form of apparatus embodying the invention, the reference character 10 designates a tank adapted to hold a bath 11, the bath 11 being a precipitating or coagulating bath of a type well known to those skilled in the art. The apparatus shown in Fig. 1 is particularly adapted to form regenerated cellulose tubing from viscose but it is to be understood that the invention is not limited to the use of these materials.

Projecting into the tank 10 through the bottom wall 12 thereof is an extruding nozzle 13 provided with an annular extrusion chamber 14 which terminates at its upper end in an annular orifice 15. The annular chamber 14 is connected by a pipe 16 to a supply of viscose which is pumped to the annular chamber 14 by suitable means (not shown).

Projecting through the extrusion nozzle 13 and disposed concentrically therewith is a tubular core 18. It will be noted that the lower end of the core 18 is of reduced diameter and that an annular chamber 20 is provided between the lower end of the core and the extrusion nozzle. A pipe 21 connects the annular chamber 20 with a supply of precipitating or coagulating fluid

which is pumped to the chamber 20 by suitable means (not shown). The fluid supplied to the chamber 20 is preferably identical with that employed in the bath 11 but not necessarily so. During the operation of the improved apparatus, the fluid supplied to the annular chamber 20 flows upwardly to the upper edge of the core 18 and is then discharged into the core. The liquid thus discharged into the core is withdrawn therefrom through a pipe 22.

Projecting through the hollow core 18 and disposed concentrically therewith is a tube 25 which, at its upper end, is provided with an outwardly extending annular flange 26. It will be noted that the upper end of the tube 25 is disposed at a considerable distance above the surface of the bath 11. Means (not shown) pump precipitating or coagulating fluid through the tube 25 to the upper end thereof, whereupon the fluid gravitates downwardly and is discharged through the hollow core 18 and the pipe 22.

A pipe 30 formed into a ring, is disposed adjacent the upper end of the tube 25 and concentrically therewith. A pipe 31 connects the pipe 30 to a supply of precipitating or coagulating fluid which is pumped to the pipe 30 through the pipe 31 by suitable means (not shown). The pipe 30 is provided with numerous small holes 32 through which the liquid pumped to the pipe 30 is discharged.

During the operation of the improved apparatus, the viscose is discharged through the annular orifice 15 to form the seamless cellulose tubing or casing 35. It will be noted that the tubing 35 is disposed concentrically with the hollow core 18 as it passes upwardly through the bath 11, there being a small annular space 36 between the inner surface of the tubing 35 and the outer surface of the core 18. The tubing 35 passes between the tube 25 and the pipe 30 to a roller 38 supported by any suitable means (not shown). From the roller 38, the tubing 35 preferably passes to additional baths as is well known to those skilled in the art.

As the tubing 35 issues from the annular orifice 15, its outer side is subjected to the action of the bath 11 and its inner side is subjected to the action of the coagulating or precipitating liquid forced upwardly through the annular chamber 20 and the annular space 36 to be discharged through the hollow core 18 and the pipe 22. The precipitating or coagulating liquid discharged from the upper end of the tube 25 is sprayed upon the inner surface of the tubing 35 and gravitates down along the surface to be discharged through the hollow core 18 and the pipe 22. The liquid issuing through the holes 32 in the pipe 30 is sprayed upon the outer surface of the tubing 35 and gravitates downwardly along this surface to fall into the bath 11. Any suitable means (not shown) may be employed for maintaining the proper level of the bath 11.

Obviously, gases evolved within the tubing 35 as it passes to the roller 38 may pass from the apparatus through the hollow core 18 and the pipe 22.

The coagulating or precipitating fluids sprayed from the tube 25 and the pipe 30 may be of the same composition as the bath 11 but they may also be of a different composition.

Referring now to Fig. 2 wherein another form of the invention is illustrated, the reference character 50 designates a tank adapted to hold a bath 51 which may be identical with the bath 11 described above and which will have the same function. Projecting through the bottom wall 52 of the tank 50 is an extrusion nozzle 54 provided with an annular extrusion chamber 55 which terminates at its upper end in an annular orifice 56 through which viscose is extruded into the bath 51 to form seamless cellulose tubing 58 which travels upwardly to a roller 59 supported by any suitable means (not shown). Viscose, or any other or suitable compound, is pumped to the annular chamber 55 through a pipe 60 by suitable means (not shown).

Projecting through the nozzle 54 and disposed concentrically therewith is a hollow core 62, the lower end of which is of reduced diameter so that an annular space 63 is formed between the core 62 and the nozzle 54. The outside diameter of the upper end of the core 62 is slightly less than the inside diameter of the cellulose tubing 58 so that an annular space 66 is provided between the outer surface of the core 62 and the inner surface of the cellulose tubing 58. Liquid or gases discharged into the hollow core 62, as hereinafter described, are discharged therefrom through a pipe 68 at the lower end of the core.

Any suitable precipitating or coagulating fluid is pumped to the annular chamber 63 through a pipe 70 by suitable means (not shown). This liquid flows upwardly from the chamber 63 through the annular space 66 and is discharged into the core 62 through apertures 71, the apertures 71 being preferably at approximately the same level as the upper surface of the bath 51. At its upper end, the core 62 is provided with a plurality of holes 73 through which gases may pass from the annular space 66 into the core 62. It will be noted that the holes 73 are inclined downwardly from the inner surface of the core 62 to the outer surface thereof. With this construction, liquid flowing downwardly in the annular space 66 from the upper end of the core 62 will be discharged into the core 62 through the apertures 71 rather than through the holes 73.

Projecting through the core 62 and disposed concentrically therewith is a tube 75 which is provided at its upper end with an outwardly extending annular flange 76. The flange 76 forms a closure for the upper end of the core 62. A tube 78 projecting upwardly from the flange 76 communicates with the interior of the core 62 and with that portion of the tubing 58 extending between the roller 59 and the upper end of the core 62. Obviously, gases accumulating in that section of the tubing 58 may pass into the core 62 through the tube 78.

Disposed around the upper end of the core 62 is a pipe 80 which is formed into a ring and is provided with numerous small holes 81 through which a coagulating or precipitating liquid is sprayed upon the outer surface of the tubing 58. This liquid is pumped to the pipe 80 through a pipe 82 by any suitable means (not shown).

During the operation of the apparatus shown in Fig. 2, precipitating or coagulating fluid is pumped upwardly through the tube 75 by any suitable means (not shown) and this liquid is sprayed from the upper end of the tube 75 against the inner surface of the tubing 58 to gravitate downwardly along that surface until it is discharged into the hollow core 62 through the apertures 71.

The coagulating or precipitating liquid sprayed from the pipe 80 and the upper end of

the tube 75 need not be of the same composition as that of the bath 51.

The upper end of the core 62 is preferably provided on its outer surface with helical threads 90 which aid in distributing the liquid issuing from the tube 75, on the inner surface of the tubing 58. The threads 90 may also be described as spiral ribs.

For the purpose of carrying away the gases evolved within the section of tubing 58 disposed below the roller 59, the core 62 may be tapered slightly in the upward direction.

In this disclosure, the words "precipitating" and "coagulating" have been used interchangeably and should also be employed to include any so-called regenerating solutions of the type utilized to regenerate compounds of cellulose.

While we have shown and described certain embodiments of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims, in which it is our intention to claim all novelty inherent in our invention as broadly as permissible, in view of the prior art.

We claim:

1. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, means for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a film thereof, and means above said bath for subjecting said film to additional precipitating solution while it continues to move upwardly from said bath.

2. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, means for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a film thereof, and means above said bath for spraying said film with additional precipitating solution while it continues to move upwardly from said bath.

3. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, and means above said bath for subjecting said tube to additional precipitating solution while it continues to move upwardly from said bath.

4. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extruding nozzle for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, and means above said bath for spraying additional precipitating solution on the outer surface of said tube while it continues to move upwardly from said bath.

5. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extruding nozzle for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, and means above said bath for spraying additional precipitating solution on the inner surface of said tube while it continues to move upwardly from said bath.

6. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extruding nozzle for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, and means above said bath for spraying additional precipitating solution on the inner and outer surface of said tube while it continues to move upwardly from said bath.

7. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, means for subjecting the inner surface of said tube to precipitating solution as it is extruded from said annular orifice, and means above said bath for spraying precipitating solution on the inner surface of said tube while it continues to move upwardly from said bath.

8. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, means for subjecting the inner surface of said tube to precipitating solution as it is extruded from said annular orifice, and means above said bath for spraying precipitating solution on the outer surface of said tube while it continues to move upwardly from said bath.

9. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, means for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a film thereof, supporting means above said bath over which said film passes while it is being formed, and means between said bath and said supporting means for subjecting said film to additional precipitating solution while it continues to move upwardly from said bath.

10. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solutions, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, supporting means above said bath over which said tube passes while it is being formed, and means between said bath and said supporting means for spraying precipitating solution on the inner surface of said tube while it continues to move upwardly from said bath.

11. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solutions, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, supporting means above said bath over which said tube passes while it is being formed, and means between said bath and said supporting means for spraying precipitating solution on the outer surface of said tube while it continues to move upwardly from said bath.

12. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, a core projecting upwardly from said nozzle, said core being disposed so that said tube surrounds it when it travels upwardly from the annular orifice, and means projecting through said core for spraying the inner surface of said tubing with precipitating solution while it continues to move upwardly from said bath.

13. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, a core projecting upwardly from said nozzle, said core being disposed so that said tube surrounds it when it travels upwardly from the annular orifice, means projecting through said core for spraying the inner surface of said tubing with precipitating solution, and means above said bath for spraying the outer surface of said tube with precipitating solution while it continues to move upwardly from said bath.

14. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, a core projecting upwardly from said nozzle to approximately the upper surface of said bath, said core being disposed so that said tube surrounds it when it travels upwardly from the annular orifice, and means projecting through said core for spraying the inner surface of said tubing with precipitating solution at a point above said bath while it continues to move upwardly from said bath.

15. Apparatus of the kind described comprising a receptacle for holding a bath of precipitating solution, an extrusion nozzle having an annular orifice for extruding a compound in fluid form upwardly through and in a substantially vertical direction above said precipitating solution to form a seamless tube thereof, a core projecting upwardly from said nozzle to a point a relatively large distance above said bath, said core being disposed so that said tube surrounds it when it travels upwardly from the annular orifice and said core being provided with a passage through which precipitating solution is forced and sprayed on the inner surface of said tubing above said bath while it continues to move upwardly from said bath.

16. A method of forming seamless tubing from a cellulosic compound in fluid form, which method comprises extruding the compound upwardly in tubular form into a bath of precipitating solution, leading the tubing thus formed upwardly from said bath in substantially a vertical direction from the surface thereof, and subjecting the inner surface of said tubing to precipitating solution at a point above said bath while it is traveling in said direction.

17. A method of forming seamless tubing from a cellulosic compound in fluid form, which method comprises extruding the compound upwardly in tubular form into a bath of precipitating solution, leading the tubing thus formed upwardly from said bath in substantially a vertical direction from the surface thereof, and subjecting the outer surface of said tubing to precipitating solution at a point above said bath while it is traveling in said direction.

18. A method of forming seamless tubing from viscose in fluid form, which method comprises extruding the viscose upwardly in tubular form into a bath of precipitating solution, leading the tubing thus formed upwardly from said bath in substantially a vertical direction from the surface thereof and subjecting the inner surface of said tubing to precipitating solution at a point above said bath while it is travelling in said direction.

19. A method of forming seamless tubing from viscose in fluid form, which method comprises extruding the viscose upwardly in tubular form into a bath of precipitating solution, leading the tubing thus formed upwardly from said bath in substantially a vertical direction from the surface thereof and subjecting the outer surface of said tubing to precipitating solution at a point above said bath while it is travelling in said direction.

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