

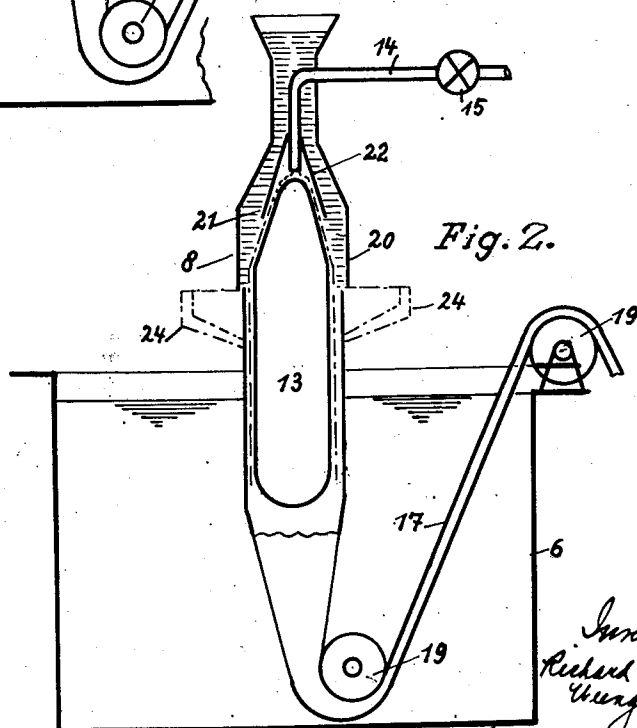
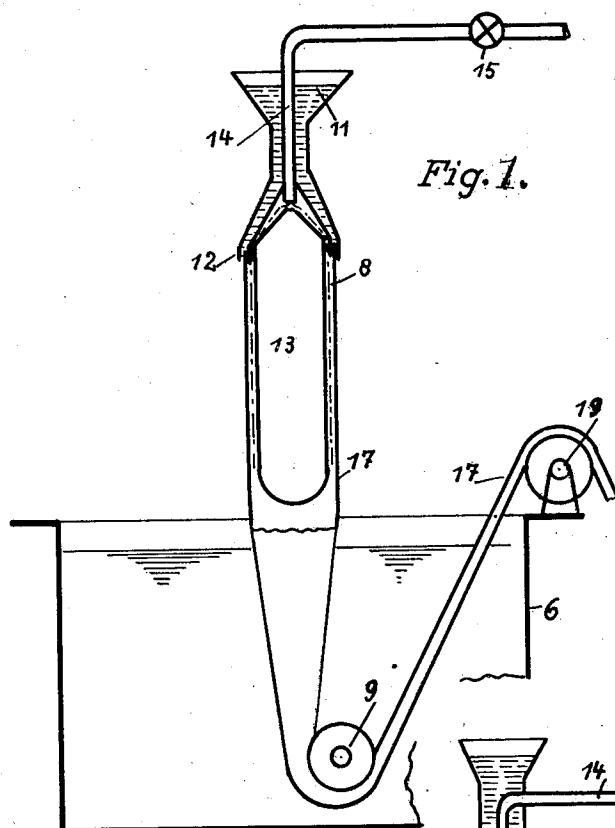
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APPARATUS FOR MANUFACTURING SEAMLESS FLEXIBLE TUBES FROM CELLULOSE SOLUTIONS

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APPARATUS FOR MANUFACTURING SEAMLESS FLEXIBLE TUBES FROM CELLULOSE SOLUTIONS

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This invention relates to a process of manufacturing seamless flexible tubes from cellulose solutions.

It has already been proposed to make seamless flexible tubes from solutions of cellulose by forcing the originating solution, under considerable pressure, through a long passage formed between two coaxial cylinders, and to bathe the resulting layer with a precipitant liquid, inside and out, on issuing from said passage, compressed air being simultaneously admitted into the interior of the tube in order to preserve its tubular shape. The employment of compressed air and pressure complicates this method of operation, and the requisite apparatus therefor, and easily leads to working troubles. Moreover, the admission of compressed air into the interior of the tube in course of formation, makes it very difficult to obtain a uniform thickness of material and a uniform diameter throughout the flexible tube, since in practice, the air pressure is not uniform, and the resulting tube is still very ductile. Attempts have therefore been made to produce seamless flexible tubes from cellulose solutions by immersing corresponding formers into the originating solution; but only comparatively short tubes can be obtained by this method.

According to the present invention, the production of seamless flexible tubes of any desired length from cellulose solutions is effected in a simple manner of operation and by a simple apparatus without the aid of pressure or compressed air in that the cellulose solution issuing from an annular nozzle, of the shape of the flexible tube, is caused to flow into a coagulating bath, whilst at the same time a precipitant is introduced inside the nozzle and the tubular layer issuing therefrom. The flowing of the cellulose solution into the precipitating bath may take place directly from the annular nozzle dipping in this case into the precipitating bath, the precipitant liquid being introduced into the interior of the tube formed in the coagulating bath, or it may be employed as a guide member along which the cellulose solution issuing from the annular tube in tubular layer flows by gravity towards the precipitating bath

and which guide member is bathed on its surface with a coagulating liquid.

When the cellulose solution is caused to flow directly into the coagulating bath from an annular nozzle dipping slightly into this bath, the tubular layer of cellulose solution is influenced immediately after its issue from the nozzle by the precipitant from the inside and from the outside so as to produce a coagulation at both the sides simultaneously with the formation of the tube. In order continually to replenish the precipitant acting inside the flexible tube in course of formation, which precipitant is rapidly used up, the spent portion of said precipitant, which is of lower density than the unconsumed portion, can be removed by a siphon and suction device. The supply and removal of the interior precipitant is preferably effected by maintaining the liquid inside the flexible tube in course of formation at the same level as, or somewhat higher than, that of the external coagulating bath.

This can be effected by simple means, for example by arranging for the other end of the siphon serving to remove the spent interior precipitant to dip into the outer coagulating bath, from which latter the spent precipitant can pass away through an overflow. In this manner also a continuously uniform balance of pressure is maintained between the interior and exterior precipitating liquid, a circumstance of importance for the uniformity of the flexible tube to be produced, and for avoiding a shrinkage of this tube. The supply and removal of the interior precipitant liquid are preferably effected in countercurrent, the supply tube debouching as far below the level of the liquid as possible, and the spent precipitant liquid, which ascends by reason of its lower density, being drawn off.

When, on the other hand, the flowing of the cellulose solution from the annular nozzle to the precipitating bath takes place along a guide member bathed with precipitant liquid inside the flexible tube to be formed, the cellulose solution is coagulated internally immediately on issuing from the nozzle and assuming the tubular form, and the layer

of precipitant surrounding continuously and uniformly the guide member on its whole surface and length enables the formed tube of cellulose solution to slide only by gravity along the guide member towards the precipitating bath. A shrinkage during this sliding movement is prevented by guiding the moving layer on a solid body during the coagulation. The resulting tube detaches itself automatically from the lower end of the guide member and then, is coagulated in the fixing bath also from the outside. The guide member may wholly or partly dip into the coagulating bath. The amount of the coagulant supplied to the guide for bathing the same, is preferably so adjusted that it will be completely consumed during the coagulation from the inside so that no excess of liquid accumulates during the formation of the tube in the interior of this tube.

The accompanying drawing shows by way of example several embodiments of apparatus suitable for carrying the process according to the invention into practical effect. Figures 1 and 2 illustrate two apparatus embodying the invention.

In the embodiment of the invention illustrated in Fig. 1, the cellulose solution is fed into a funnel 11 which merges into an annular nozzle 12, into the inner rim of which projects a guide member 13, which may, for example be cylindrical. A tube 14 passing through the annular nozzle 12 serves for supplying the coagulating liquid to the guide member 13, and is provided with a central valve 15. Below the guide member 13 is the fixing bath 16. The cellulose solution issues from the annular nozzle 12 and flows, by gravity, along the guide member 13.

This guide member is continuously irrigated all over with coagulating liquid issuing from the supply tube 14 as illustrated diagrammatically by the dotted line 8 in Fig. 2, so that the cellulose solution is immediately coagulated internally on issuing from the annular nozzle. The descending tube 17 thus formed detaches itself automatically from the lower end of the guide member 13, and sinks into the fixing bath 16 where the external coagulation is effected.

The solidified tube 17 can then be removed from the fixing bath 16, over rollers 19, and can be treated in a continuous manner in the usual washing, bleaching, desulphurizing, colouring and plasticizing baths, followed, if desired, by drying. By adjusting the control valve 15, the supply of coagulating medium to the guide member 13, and thereby the rate of removal of the tube can be regulated.

As illustrated in Fig. 2, the annular nozzle may be replaced by a cylindrical tube 20, into which the slightly conical upper end 21 of the guide member 13 is inserted, so that the thickness and form of the tube in course of

formation, is determined by the space between these two members which may be adjustable. In order to ensure the supply of coagulating medium to the guide member 13, the tube 14 serving to supply the same, may be provided at its lower end with a conical cover 22.

Fig. 2 further shows that the external coagulation of the tube may also be effected while the tube is still on the guide member 13, inasmuch as this member may for example be immersed in the fixing bath. Instead of this however, the tube may be externally irrigated with precipitant by means of an annular nozzle 24 shown, in dotted lines, in Fig. 3. The resulting tube may serve for any desired purposes and may be employed for example as an artificial intestine.

What I claim is:

In an apparatus for the continuous manufacture of seamless flexible tubes from cellulose solutions comprising an annular nozzle, a conduit for supplying cellulose solution to said nozzle, a guide member for the cellulose solution issuing from said nozzle, a tube traversing said nozzle and supplying precipitant to said guide member and a vessel containing a fixing bath, the guide member being arranged beneath the annular nozzle and the vessel being situated below the guide member.

In testimony whereof I affix my signature.
RICHARD WEINGAND.