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(54) **CANTILEVER EXPANSION SHAFT**

(57) A cantilever expansion shaft (1) comprising an axial sliding mechanism, preferably made of rolls (2) partially countersunk into the shaft and apparatuses comprising a cantilever expansion shaft.

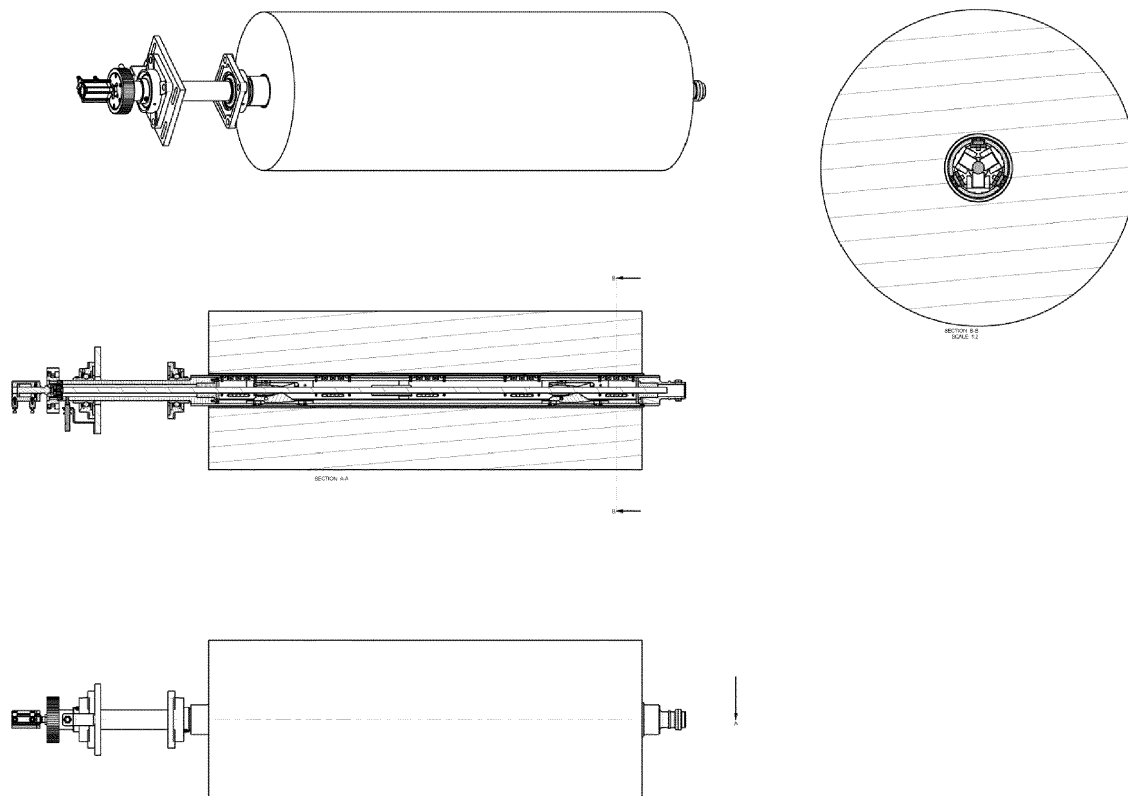


Fig. 4

Description

[0001] The invention pertains to cantilever expansion shafts and to apparatuses comprising a cantilever expansion shaft.

[0002] Expansion shafts (also known as expansion shafts or expansion axis) are widely used for handling winding reels in the processing of web-fed materials as for example is common in the coating, laminating and printing industry.

[0003] The expansion shaft is usually fitted into a core onto which film like materials (such as paper, plastic film, metal foils, etc.) are wound. The core onto which film like material is wound is also referred to as a reel. An expansion shaft is designed such that it can be slid into the core of the reel and expanded to fix to the core onto the shaft. The expansion shaft can also be contracted such that the shaft may be removed from the core. The expansion shaft makes it possible to grip the core without damage and at the same time it provides an interface for handling/controlling the core and web via motors and brakes.

[0004] The expansion/contracting mechanism in the expansion shaft is normally driven pneumatically or mechanically. A pneumatic expansion shaft may also be referred to as an air expanding shaft or airshaft. A pneumatic expansion shaft tightens to the core by filling the shaft with air. Although multiple designs exist, a pneumatic expansion shaft typically contains one or more air inflatable compartments that upon inflation press against lugs. The lugs are pressed outwards and grip into the inside of the core. The pneumatic system makes it relatively simple to use this type of shaft. However, the weight of the shaft and/or core (with film like material) might cause the shaft to clamp to the core in a non-concentric way. Also the applied gripping force is limited when compared to the mechanical expansion shaft. A mechanical expansion shaft works on similar principles as the pneumatic version, however, the outward motion of the lugs is driven by a mechanical movement such as turning a screw. This type of shaft has the advantage of a more concentric clamping and high gripping force.

[0005] Expansion shafts are usually inserted into the core or reel. The expansion shaft, including the core/reel, is then positioned on both sides into bearings. However, in some cases the core or reel is slid over the expansion shaft instead of the expansion shaft inserted into the core or reel. The expansion shaft is on one side (permanently) fixed and the other side is free such that the core or reel can slid over the shaft. This particular design is known as a cantilever expansion shaft and is particularly useful when handling cores/reels that are relatively narrow and low weight. Common cantilever expansion shafts thus have therefore normally a length of <1 meter

[0006] It is one objective of this invention to provide expansion shafts that are capable to also handle cores/reels of greater width and/or weight. More in particular the invention is related to provide cantilever ex-

pansion shafts that are useful for a process wherein a continuous process for making coated adhesive tapes is described comprising the steps of dosing a polymerizable mixture containing mono ethylenically unsaturated monomers and/or oligomers on a carrier foil, guiding the mixture on the carrier foil through a UV-light curing zone to initiate the polymerization and forming the adhesive tapes, releasing the carrier foil and taking up the adhesive tapes, which process sets forth that a dry coating film is positioned between the carrier foil and the polymerizable mixture to form the coated pressure sensitive adhesive tape.

[0007] Such a process is e.g. disclosed in EP 0 259 094 A2, US 4 894 259 and in EP 2 147 025 B1 and may essentially be described as follows:

[0008] A polymerizable mixture containing mono ethylenically unsaturated monomer and/or oligomers is dosed on a carrier foil. The polymerizable mixture might also contain non polymeric fillers and additives such as hollow glass/plastic spheres, fumed silica, talc, aluminum trihydrate, quartz powder, etc.

[0009] The dry coating does not contain any significant amount of carrier fluid such as solvents or water. Small amounts of residual carrier fluids (typically no more than 10%, preferably even less than 2% and most preferably 0%) might be present in the coating material since the coating materials can be applied to a carrier foil via wet processing. The residual carrier fluids might be left in the coating even after removal (e.g. evaporation) of the carrier fluids. These carrier fluids typically have viscosity of less than 25 mPas and most of them have a viscosity which is even below 5 mPas. A carrier fluid is a fluid that is used to modify the viscosity of a coating formulation such that the coating materials can be processed via wet processing. A dry coating is obtained by extracting the carrier fluid from the coating via evaporation. Examples of typical carrier fluids are water and solvents such as acetone, acetonitrile, benzene, butanol, carbon tetrachloride, chloroform, cyclohexane, 1,2- dichloroethane, dichloromethane, dimethyl formamide, dimethyl sulfoxide, dioxane, ethanol, ethyl acetate, ethyl ether, heptane, hexane, Isopropyl alcohol, methanol, methyl-t-butyl ether, methyl ethyl ketone, pentane, tetrahydrofuran, toluene, and xylene.

[0010] The viscosity of the carrier fluids is measured at 20 °C with an Ostwald viscometer.

[0011] The coating material is preferably a polymeric material with adhesive properties. It can for example be based on a thermoplastic hot melt adhesive such as Ethylenevinyl acetate (EVA), Ethylene-acrylate copolymers, Polyolefins (PO), Polyamides (PA) and polyesters, Polyurethanes (PU) and Styrene block copolymers. The coating material can also be a pressure sensitive adhesive (PSA). PSA's are typically based on elastomeric polymers (often compounded with tackifiers) that are based on acrylics, butyl rubber, ethylene-vinyl acetate (EVA), natural rubber, nitriles, silicone rubbers and styrene block copolymers.

[0012] The coating material can be based on materials that have a glass transition temperature. The coating material can consist of a viscous material, in case the coating material is a polymer, which is not cross-linked and which has a glass transition temperature below room temperature. Although the coating material might be a viscous material, it does not mean that it is wet material since it does not contain any carrier fluid such as solvents or water. Preferably, the viscosity of such a viscous coating material is higher than 2 Pas, even more preferably it is higher than 10 Pas.

[0013] The dry coating is a layer that comprises a polymerizable mixture containing mono ethylenically unsaturated monomers and/or oligomers. Thus, two layers of polymerizable mixtures are formed on top of each other. Each mixture can be designed differently and, after UV curing, each layer may have different adhesive (and cohesive) properties. The resulting product - although comprising two layers - would still form one single tape which just has a two-layer-structure. By doing so, one would be able to create a tape which has on each side a different adhesive/cohesive property. For example one would be able to make a tape which is ideal for bonding two totally different substrates like a metal with a plastic. One layer is designed for adhesion to metal; the other layer is designed for adhesion to plastic.

[0014] From a production point of view one could dose the first polymerizable mixture, if needed (partially) UV cure the mixture, and then apply the second polymerizable mixture. If the first polymerizable mixture is not sufficiently hardened or sufficiently viscous, the two layers with polymerizable mixtures could mix and form one more or less homogenous composition.

[0015] The viscosity of suitable monomers would be within the range of < 25mPas. However, these materials are excluded from the list of carrier fluids since these compounds are not extracted via evaporation from a coating to obtain a dry coating. Instead these materials can polymerize into a dry coating. Monomers are therefore not considered a carrier fluid. Monomers do not "carry" the dry coating; instead they form the dry coating.

[0016] To this end the dry coating comprises or is made of essentially the same components as mentioned above for the backing material.

[0017] The UV-light zone is preferably based on low intensity UV light (<20 mW/cm²) with a wavelength that is predominantly between 320-400 nm. The UV-light zone consists of multiple UV lamps that might be located on one side of the carrier foil on which the polymerizable mixture of mono ethylenically unsaturated monomers and/or oligomers is dosed. Preferably, the UV-light zone consists of multiple UV lamps that are located on both sides of the carrier foil on which the polymerizable mixture of mono ethylenically unsaturated monomers and/or oligomers is dosed.

[0018] The releasing carrier foil is preferably based on a bi-axially oriented p-polyethylene terephthalate (BO-PET). Even more preferably the surfaces of the BO-PET

are siliconized and most preferably the surfaces are differential siliconized. In the latter case the release value of the silicon layer on both surfaces of the BO-PET is different. It should be mentioned that the siliconization on the carrier foil is not a dry coating as claimed in the invention since it does not adhere to the polymerizable mixture after polymerization of said mixture in the UV-zone. In contrary, the siliconization aims to facilitate easy release of the polymerized mixture after polymerization and will not adhere to it.

[0019] Preferably a second foil is used to cover the polymerizable mixture of mono ethylenically unsaturated monomers and/or oligomers. By sandwiching the polymerizable mixture between the carrier foil and a second foil it is avoided that oxygen can inhibit the polymerization reaction by which the polymerizable mixture is hardened in the UV-zone. The second foil is preferably based on a bi-axially oriented p Polyethylene terephthalate (BO-PET). Even more preferably the surfaces of the BO-PET are siliconized and most preferably the surfaces are differential siliconized. In the latter case the release value of the silicon layer on both surfaces of the BO-PET is different.

[0020] The process can be carried out on equipment as further elucidated by Fig. 5 and 6. Such an equipment comprises as components a dispenser for dosing a polymerizable mixture on a carrier foil, a roller-knife-coater, one or more means for supplying and retrieving carrier foils, second foils and/or protection foils, a UV-light curing system, a means for taking up the tapes and a means for transporting the polymerizable mixture on the carrier foil from the dispenser to the taking-up means. In particular during such a process it is necessary to slide reels of carrier foils and cores over a cantilever expansion shaft.

[0021] Cantilever expansion shafts are particularly useful for this process since an equipment, as shown in Fig. 5 and 6, allows minimal space for handling cores, reels and expansion shafts. In particular the siliconized bi-axially oriented polyethylene terephthalate (BOPET) production liners applied in a process as mentioned above need to be handled carefully. The layers of siliconized BOPET can easily slip due to the low friction between the layers of siliconized BOPET. When mechanical force is applied to the side of a roll of siliconized BOPET (as for example is done when the roll of siliconized BOPET is placed over a cantilever expansion shaft), layers of siliconized BOPET can easily slip causing a distorted roll of siliconized BOPET to be placed on the cantilever expansion shaft. Besides problems from a production point of view, this also causes dangerous situations when the roll of siliconized BOPET is placed on the cantilever expansion shaft.

[0022] This invention aims to overcome the restrictions of known cantilever expansion shaft designs and in particular when handling wide and/or heavy reels with low friction material such as siliconized BOPET.

[0023] This is achieved by having a cantilever expan-

sion shaft with an axial sliding mechanism. In the course of present invention the term "axial sliding mechanism" is used in the broadest possible way and includes any means that facilitate moving or sliding cores or reels over the expansion shaft in a direction parallel to the axis of the expansion shaft.

[0024] In one very simple embodiment the expansion shaft can be foreseen with a layer or a coating that facilitates gliding, i.e. a layer of low friction material. This can e.g. be a polytetrafluorethylene foil or coating. Also other (plastic) materials may be applied, such as, but not limited to phenolics, acetals, ultra high molecular weight polyethylene (UHMWPE), and nylon.

[0025] In another embodiment the expansion shaft can be foreseen with air bearings. Air bearings use a thin layer of pressurized air as a low-friction interface between surfaces. The air bearing can be switched on when heavy reels of materials needs to be placed on/removed from the shaft. Once the reel is installed on the shaft, the air bearing can be switched off to maximize clamping of the reels on the shaft during production.

[0026] While these embodiments serve the purpose it is - for the high operational demands - more preferred to insert rolls or balls onto or partially into the expansion shaft, such that the reel or core can be "rolled" along the axis of the cantilever shaft.

[0027] A preferred embodiment is exemplified by Fig. 1. Here an expansion shaft 1 is shown which comprises sets of rolls 2 which rolls rotate in axial direction to allow a reel or a core to easily be moved onto the shaft. In the Fig. 1 two sets of three rolls each are shown located on opposite sides of the shaft. The numbers of rolls or sets of rolls are not limited and can be chosen to best fit the purpose. The rolls can be placed on the shaft or - as preferred and shown in Fig. 1 - partially countersunk into the roll. It is sufficient and also preferred that the rolls only slightly project over the surface of the shaft to serve the purpose.

[0028] It goes without saying that the same effect can also be achieved with balls that are rotatable integrated into the shaft.

[0029] The rolls or balls can be made of steel, essentially of the same material as the shaft itself. Also other materials are possible, such as ceramics or plastics, as e.g. polyethylene, nylon, polytetrafluorethylene and so on.

[0030] A shaft according to the invention typically has a rod or pole like shape. The cross-section of the shaft can have any shape, but it is preferably ellipsoidal, rectangular, square, pentagonal, hexagonal, heptagonal, octagonal, nonagonal or decagonal. Most preferably the shape is round.

[0031] The invention also pertains to apparatuses which contain a cantilever expansion shaft comprising an axial sliding mechanism. Such apparatuses can be many types equipment and in particular web handling equipment. One such apparatus is for example described below with regard to Fig. 5 and 6. Another apparatus

would be a device that facilitates the positioning/removal of reels from a cantilever shaft. Said device contains a cantilever expansion shaft with an axial sliding mechanism and can be used to pick up a reel by positioning said shaft into the reel. Said device lifts the reel into position (i.e. parallel and in line with another device that contains a cantilever expansion with an axial sliding mechanism). Once positioned, the reel can be easily moved from one cantilever expansion shaft to the other. Said apparatus thus provides a simple mechanism for lifting, handling and positioning of reels.

Fig. 1 further shows a lug 3, which can be pressed against the reel or the core in order to better fixate it to the shaft.

Fig. 2 shows an inventive expansion shaft 1 in operation having a roll with siliconized BOPET on it. The rolls 2 can be seen partially. The lugs cannot be seen.

Fig. 3 shows schematically the technical details of an inventive cantilever shaft 1 with the rolls 2 and the lugs 3.

Fig. 4 shows schematically the inventive cantilever shaft in operation carrying a roll located on the shaft. A process and an equipment for which the inventive cantilever shaft is suitable are further elucidated by reference to the Figures 6 and 6.

The rolls in the process and in the equipment elucidated by Fig. 5 and 6 are preferably located on cantilever shafts according to the present invention.

Fig. 5 is a schematic representation of a continuous process for making coated adhesive tapes according to the invention. The polymerizable mixture is kept in a container from which it is pumped to the roller-knife-coating system. Here the mixture is dosed on a carrier foil that contains a dry coating and said coating being positioned on the side of the carrier foil on which the polymerizable mixture is dosed. The carrier foil, dry coating and polymerizable mixture are transfer into a UV light zone. The UV light initiates the polymerization reaction of the polymerizable mixture. After hardening of the polymerizable mixture the dry coating adheres to the hardened mixture, forming a coated adhesive tape. The carrier foil and/or second foil can be removed prior to winding the coated adhesive tape into a roll. It is also possible to apply an addition release liner to the coated adhesive tape prior to winding it into a roll.

Fig. 6 is a further schematic representation of a continuous process for making coated adhesive tapes according to the invention. The polymerizable mixture is kept in a container from which it is pumped to the roller-knife-coating system. Here the mixture is

dosed on a siliconized BOPET carrier foil that contains a dry coating and said coating being positioned on the side of the carrier foil on which the polymerizable mixture is dosed. A second siliconized BOPET foil that contains a dry coating (said coating being positioned on the side of the carrier foil that faces the polymerizable mixture) is applied to the polymerizable mixture. The carrier foil, second foil dry coatings and polymerizable mixture are transfer into a UV light zone. The UV light initiates the polymerization reaction of the polymerizable mixture. After hardening of the polymerizable mixture the dry coatings adheres to the hardened mixture, forming a coated adhesive tape. The carrier foil and/or second foil are removed prior to winding the coated adhesive tape into a roll. It is also possible to apply an addition LDPE release liner to the coated adhesive tape prior to winding it into a roll (marked product)

rier foil, a roller-knife-coater, one or more means for supplying and retrieving carrier foils, second foils and/or protection foils, a UV-light curing system, a means for taking up the tapes and a means for transporting the polymerizable mixture on the carrier foil from the dispenser to the taking-up means, **characterized in that** it comprises one or more of the cantilever expansion shafts according to claims 1 to 7.

Claims

1. A cantilever expansion shaft comprising an axial sliding mechanism.
2. The cantilever expansion shaft of claim 1, wherein the sliding mechanism comprises a foil or a coating selected from polytetrafluorethylene, phenolics, acetals, ultra high molecular weight polyethylene (UHMWPE) or nylon.
3. The cantilever expansion shaft of claim 1, wherein the axial sliding mechanism comprises rollers.
4. The cantilever expansion shaft of claim 3, wherein the rollers are partially countersunk into the shaft.
5. The cantilever expansion shaft according to claim 1, wherein the axial sliding mechanism comprises balls.
6. The cantilever expansion shaft of claim 1, wherein the axial sliding mechanism comprises air bearings.
7. The cantilever expansion shaft of any of the preceding claims, wherein the shaft additionally comprises one or more lugs.
8. An equipment for positioning reels onto and/or retrieving reels from a cantilever expansion shaft according to any of preceding claims, wherein said equipment also contains an expansion shaft according to any of the preceding claims and a lifting mechanism.
9. An equipment for carrying out the process for making adhesive tapes comprising as components a dispenser for dosing a polymerizable mixture on a car-



Figure 1



Figure 2

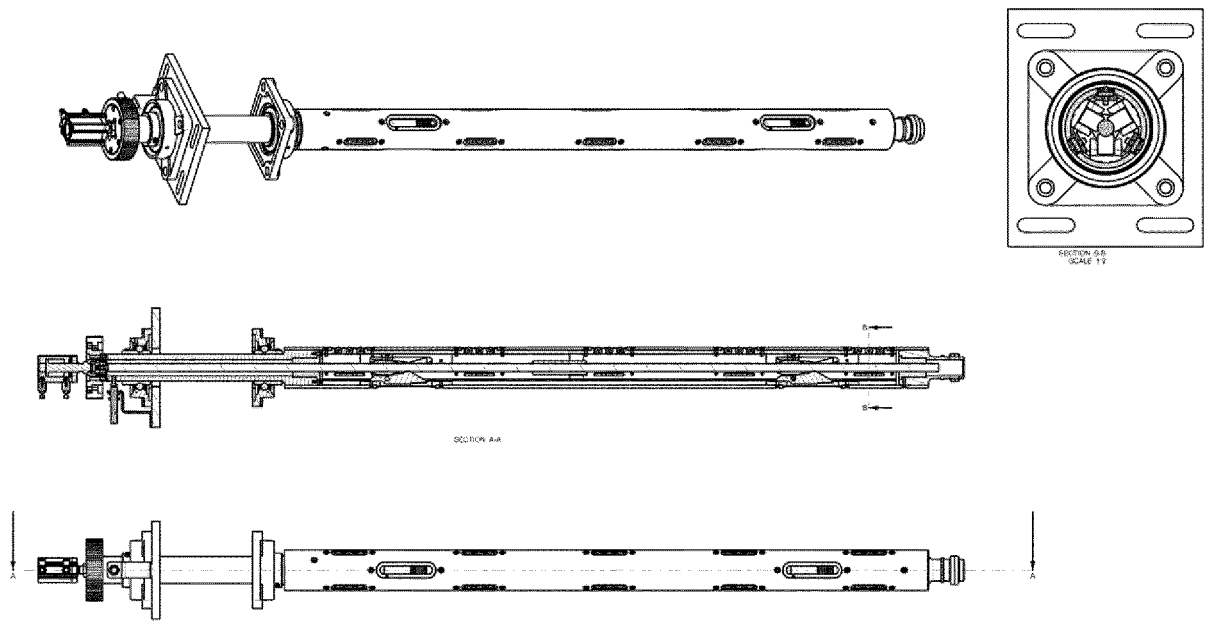


Fig. 3

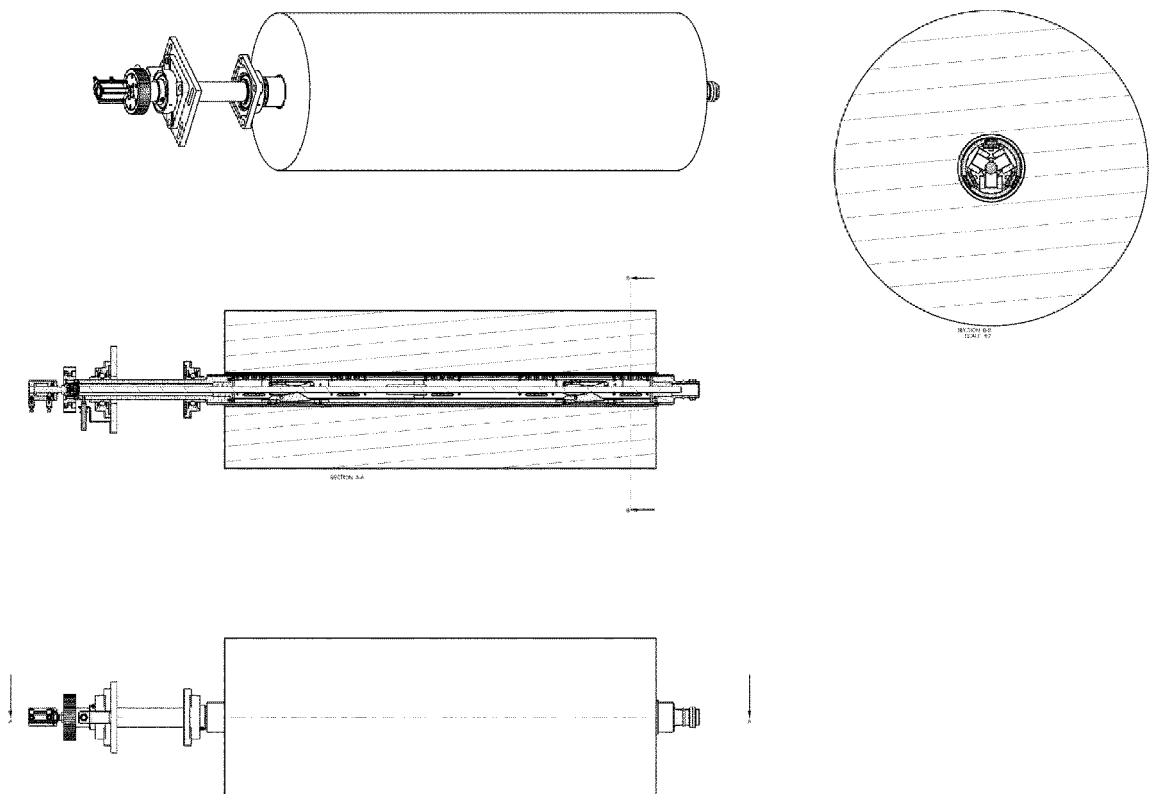


Fig. 4

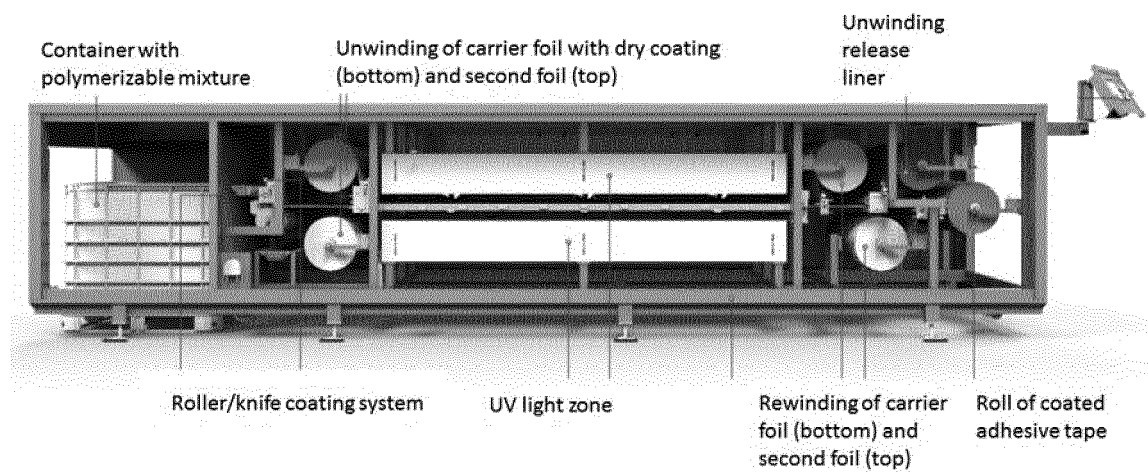


Fig. 5

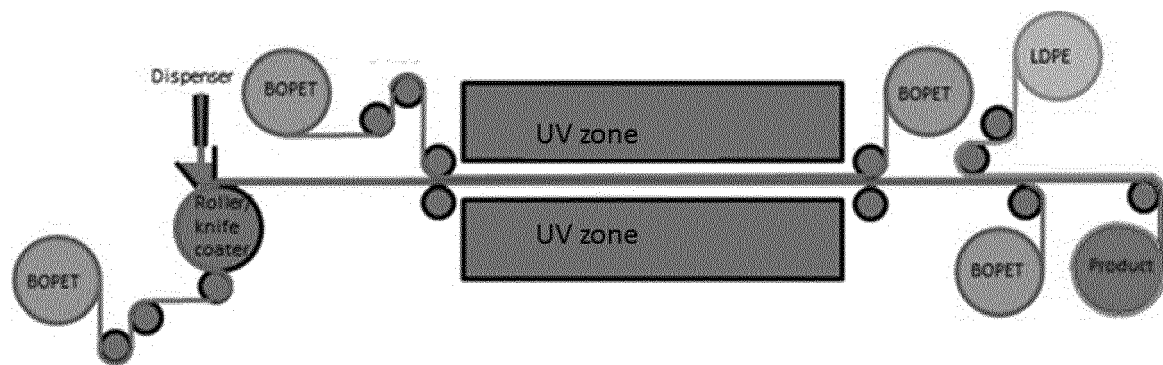


Fig. 6



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