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DEVELOPMENT OF A PROCESS AND CONSTRUCTIONS OF WINDING MECHANISMS FOR FORMING THE POROUS WALLS OF TUBULAR OVERSIZE AND UNDERSIZE TEXTILE FILTERS

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As a result of research methods and technologies for production have been developed and tubular textile filters based on special packages have been introduced into industrial production.

Keywords: special wound packages, porous walls, tubular textile filters, density of package.

It is known that the porous walls of tubular textile filters have to meet quite specific requirements for optimal flow of filtration process, namely: they must have low hydraulic resistance to the flow of liquid to be filtered (suspension) and provide the required degree of purification of suspensions, as well as degree of dispersability (fineness) of the filtrate particles. For this purpose, capillary of filtration membrane should have uniform small sizes and their number should be the highest. In addition, they must have sufficient length, so that liquid to be filtered could be in contact with the surface of partitioning material as long as possible.

From our point of view, the most appropriate design for such memranes (partitions) are spiral packages. In this case, the filtered liquid moves along the spiral winding, which significantly increases the filtration path and improves the suspenstion purification of solid particles.

In addition, tubular textile filters must detain harmful impurities and heavy metal salts what is determined by the type of fibrous materials which form the porous walls of tubular textile filters, since various materials can capture from the filtered fluid ions of metal salts and harmful impurities of a certain kind. For example, polypropylene filaments quite successfully capture the iron ions. Carbon fibers retain heavy metal ions and molecules of toxic gases. The best material for the porous walls of tubular textile filters are polypropylene filaments, because they are resistant to acids and alkalis, have a quite high melting point and have low density.

Porous walls of tubular textile filters, used in water treatment, should be user-fiendly to remove the precipitate. The cylindrical shape of porous walls allows to easily remove from their surface the precipitate formed; and resistance to acids, makes it easy to dissolve the residue when cleaning the surface of the package.

As a rule, to achieve the required quality of fluid (water) purification, THF is used in combination with other filters, sorption, precipitant and other materials and preparations.

Packages, designed for the manufacture of filters, should have high density winding, as in this case (when all other conditions being equal) they will have a minimum porosity and permeability, and thus be able to catch particles of minimum size.

The most feasible and promising way, leading to an increase in the density of the winding, is creation of serried (or seamless) structure packages.

Indeed, when winding the packing structure, consistent filling of the gap with serried coils takes place. Once the entire gap is filled with turns, winding will be closed and formation of a new bulk layer will start.

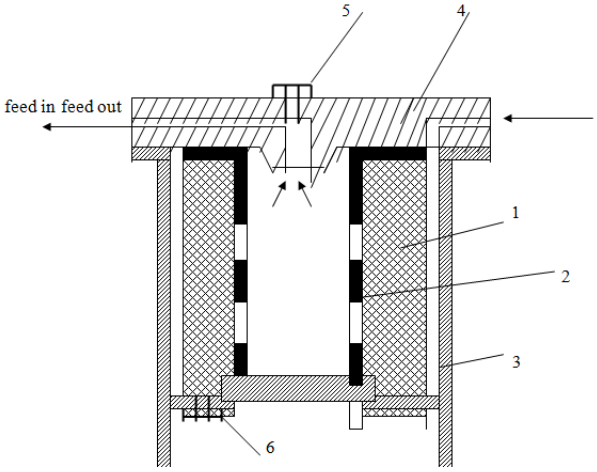
In order to form a serried winding, it is necessary to ensure a well-defined angle shift between coils.

To get the serried structure on the package (formed on a machine with the joint action of filament winding and package building mechanisms), it is necessary that characteristic of the drum increases proportionally to the contact winding diameter. The latter requirement is almost impossible to fulfill and, therefore, packages of serried structure are being formed only on machines with a separate action mechanisms of thread-winding and package building (on precision winding machines). The advantage of these winders is that they enable to get seamless winding with any diameter of rewindable yarn. However, in each case, adjustment of variator is required.

To improve the process of winding, one must know the value of the required gear ratio between the spindle and the cam of thread guide, in this case change gears can be used instead of the variator.

Aerators, porous walls of which have a greater height of winding, reaching up to two or more meters, are used in sewage treatment plants. To form porous walls with a great height, winding mechanisms are needed which provide significant swing of the thread guide for winding of packages.

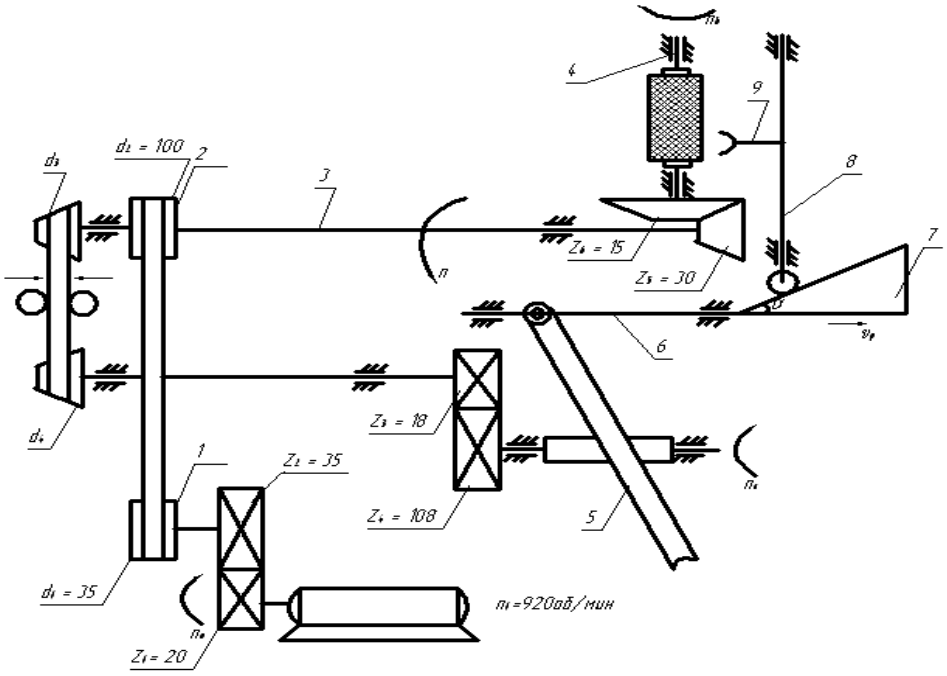
In household environment, tubular textile filters (TTF) of undersize dimensions are widely used. Construction (design) of one of them is shown in Picture 1. Supply of filtered liquid in TTF is executed to the external surface of the filtering partition 1, which is placed in a perforated holder 2. Filtering partition 1 with the cartridge 2 are placed inside the filter casing 3, which is closed with the lid 4. To wash the filter from sediment, plugs 5 and 6 are used, through which the washing liquid is fed in and fed out. Filtering partition (wall) should also in this case have a large permeability, i.e. the ability to easily pass through itself the liquids or gases to be filtered, and at the same time provide the required filtering fineness.



Picture1. Construction (design) of tubular textile filter: 1 – filtering partition; 2 – perforated holder; 3 – filter cage; 4 – lid; 5,6 – plugs

Porous wall of TTF for household use is formed on precision winding machines where spindle and thread guide have their own motions which are independent from one another. Tubular textile filters of undersize dimensions, having different heights, can be used in various fields. We have developed constructions of winding machines, allowing to form the porous walls of TTF of different heights.

Picture 2 shows the kinematic scheme of one version of constructions of such winding mechanism with a wedge gear, and Picture 3 - its external appearance.

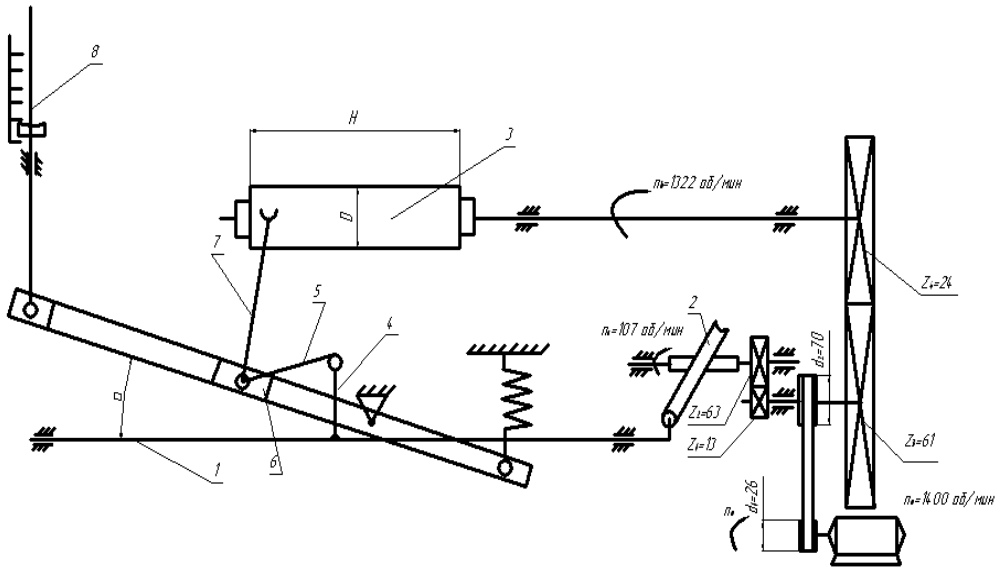


Picture 2. Kinematic scheme of winding head for the formation of TTF of undersize dimensions with the wedge gear for transmitting movements of pusher (of thread guide): 1 – electric motor; 2,3 – belt pulleyes; 4 – shaft; 5 – spindle; 6 – thread guide; 7 – conoid variator; 8 – rack; 9 – wedge-like plate; 10 – pusher; 11 – thread guide; Z_1-Z_2 and Z_3-Z_4 – toothed gears; Z_5-Z_6 – wedge toothed gear

Picture 4 shows the kinematic scheme of winding mechanism with reduced stroke of the thread guide for the formation of porous partitions of THF of undersize dimensions with different heights, and in Picture 5 – its external appearance. Different height of winding is achieved by reducing the stroke of the thread guide. The winder "Polikon" is taken here as the basis for design. Rotation is transmitted from AC motor 1 through V-belt transmission 2 and through the gears Z_1, Z_2, to the thread guide cam 3, and through gears Z_3, Z_4 to the spindle on which the package to be wound is put on 4.

Picture.3. Kinematic scheme of winding head for the formation of TTF of undersize dimensions with the wedge gear for movements of thread guide pusher

From the cam of thread guide 3, the reciprocating rod 5 receives motion having a branch 6, connected through a connecting rod 7 and through a link block 8 with the thread guide 9. The swing of thread guide 9 depends on theαinclination angle of the link to the horizontal. With increasing the angleα by raising the rod 10, swing of the thread guide is reduced and so, the height of the winding N of the porous wall of TTF decreases.



Picture 4. Kinematic scheme of the winding head for the formation of porous partitions of THF of undersize dimensions with the reduced stroke of the thread guide: 1 - electric motor; 2 - V-belt drive; 3 -cam of thread guide; 4 - spindel with a package; 5 - rod; 6 - rod branch; 7 - connecting rod; 8 - link block; 9 - thread guide; 10 - rod; Z_1-$Z_2$and Z_3-Z_4 - toothed gears

Picture 5. External appearance of winding head for formation of TTF of undersize dimensions with the reduced stroke of the thread guide

CONCLUSIONS

1. As a result of research methods and technologies for production have been developed and tubular textile filters based on special packages have been introduced into industrial production.

2. Methods for designing special wound packages with the specified parameters (pore size, specific density of package, the filter surface, hydraulic properties) have been developed;

3. It has been demonstrated theoretically and experimentally that the most suitable for the formation of the porous walls of tubular textile filters are packages of serried packing structure, because they have a higher density of winding.

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