global economy could be severely restricted, the quality of our life could be eroded forever.

And in the end ensuring the security of citizens is one of the primary obligations of any country. Without safety and security as its basis, society cannot thrive. Governments keep citizens secure by fighting crime and terrorism, protecting them against natural or man-made disasters, providing effective cyber-security and protecting borders against illegal trafficking. But while ensuring the security of citizens is an essential task of any administration, it is also a highly sensitive area that needs to incorporate respect for privacy and the safeguarding of fundamental rights. The respect of privacy and individual freedom is thus at the heart of the EU security research and innovation projects as, for example, the Tabula rasa consortium.

As you can see, Horizon 2020 brightly demonstrates a high correlation between sustainable European development and innovations, which all in all gives a powerful multiplier effect. The cooperation of these areas is needed to recruit new talents for science, to marry scientific and innovative excellence with social awareness and responsibility and to deliver more breakthroughs, discoveries and world-firsts by taking great ideas from labs to market.

Innovations alone are rarely the key to unlocking economic and social value, but it induces really creative and useful ideas when they are combined with concept of the sustainable development. Research and innovations contribute to make Europe a better place in which people can live. They improve Europe's competitiveness, boost growth and create new jobs. They help make people's lives better by improving healthcare, transport and countless new products and services, planting the seeds from which new industries and markets grow. All innovative projects which were described theoretically in this article will lead Europeans and their generations to the sustainable development in practice in the nearest future.

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NEW CHAIN STITCHES

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New chain stitching machines have been increasing their share in total nomenclature of sewing equipment from year to year for the sake of known advantage in comparison with shuttle stitching machines and also due to constant enlargement of assortment of sewing materials. These types of machines are manufactured by dozens of firms all over the world; the number of machine classes and their modifications is already measured by hundreds and constantly increases. At the same time technological processes, e.g. types of stitches made by this equipment are very seldom renowned. There are only 72 types of chain stitches, and

correspondingly the same number of ways of their formation (among them, there are only 41 types of stitches belonging to multi-thread chain ones). Even fewer ways are implemented in manufacturing equipment.

These circumstances slow down the improvement of perspective types of equipment and the enlargement of their application scope.

The task of this study is the development of new technological processes (ways of formation of multi-tread chain stitches) and the equipment for their realization.

The object of the study is the provision of required consequence of operations for the formation of new-type multi-tread chain stitches and co-work of machine's working elements in these operations.

In the development of new ways of chain stitch formation the known method of a system analysis is used, where the object (way) is estimated with elements of heuristics as a system with all its factors.

In the processing of fabrics and knitwear material, lines of Type 403 and Type 407 stitches are widely used (Fig. 1a, 1b). In particular, they serve for knitwear damping, sewing the laid-on gusset on, sewing elastic band belts on etc.

The main moments of co-work of machine's working elements during the formation of aforementioned stitches are so-called moments of pick-up (Fig. 1d), when the looper's tip consequently picks up needle loops and moments of clipping (Fig. 1e), when each needle drops into the corresponding thread triangle, formed by branches of looper's thread loop and corresponding previous needle loop.

The main problem of provision of reliable co-work of working elements is for the first moment a necessity of a reliable consequent pick-up of all three needle trade loops by a single looper. At clipping, simultaneous presence of three loops at one looper might result in dropping needles into wrong triangles, which will break stitch structure.

Aforementioned circumstances, firstly, limit width of No. 407 stitch (its maximal size is 6 to 6.2 mm), and, secondly, make adjustment of flat seam machines more complicated (their repair complexity is 5 to 6 nominal units which exceeds even that of some sewing semi-automatic machines).

Above that, using of such structure of stitch, in which sewed materials are jammed by triple-thread lines from one side and by laid-out single-thread loops from other, leads to thread over-expenditure and irregular stitch elasticity on opposite sides of materials.

The same problems also arise when No. 403 stitch is used.

One more representative of multi-tread chain stitch is Z-type No. 405 stitch (Fig. 1c), the lines of which found their application at sewing laces onto knitwear goods, braid etc.

Aforementioned basic moments of its formation are similar to that of No. 403 and No. 407 stitches; however, needle co-work with the looper in these moments is also complicated as needles have some horizontal offset in addition to a vertical one. This circumstance has large impact on reliability of stitch formation process, that is why its maximal width in existing sewing machines does not exceed 3-4 mm; it essentially reduces its application scope.

Authors have developed the ways of formation of such-like stitches with new structure which are patented in State Patent of Ukraine and do not have disadvantages stated above. Maximal width of these stitches (Fig. 2) might several times exceed the width of existing stitches; co-work of working elements during their formation also runs in more reliable way.

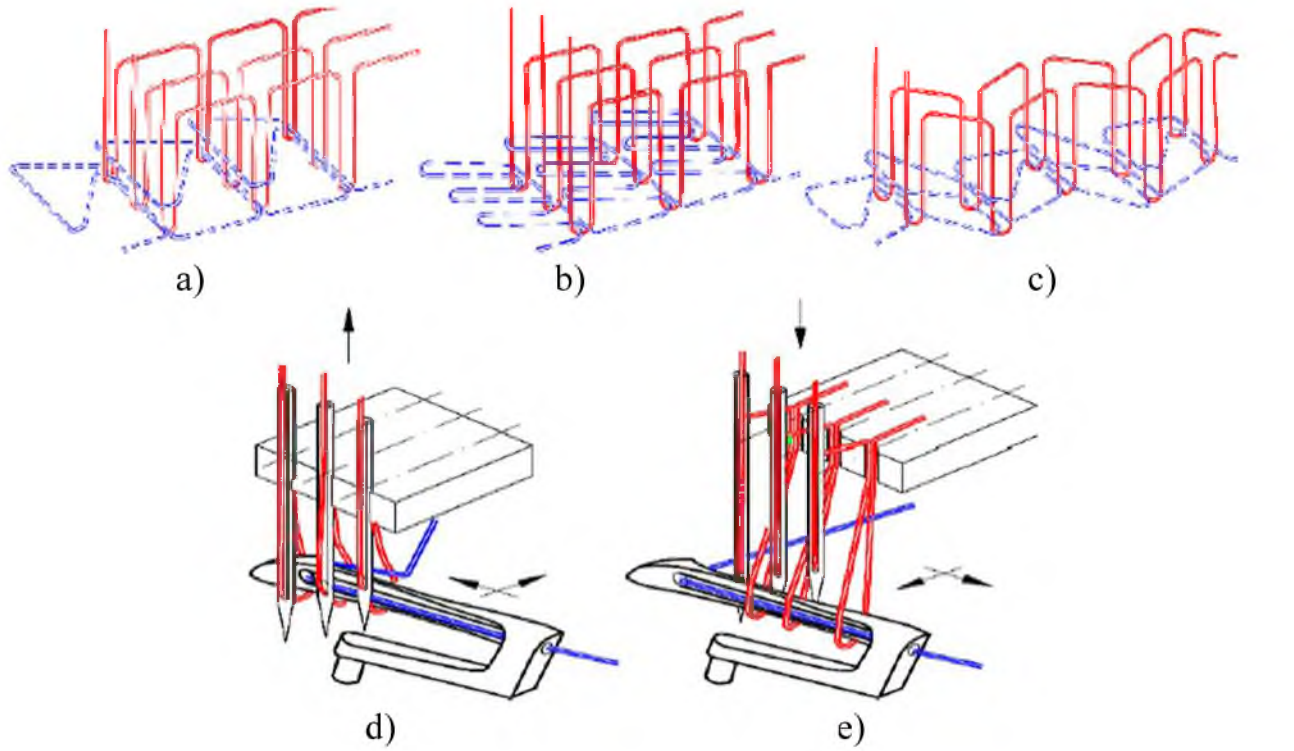

Figure 1 - a), b), c) – structure of No. 403, 407 and 405 stitches, d), e) – the main moments of co-work of working elements during the formation of flat chain stitches

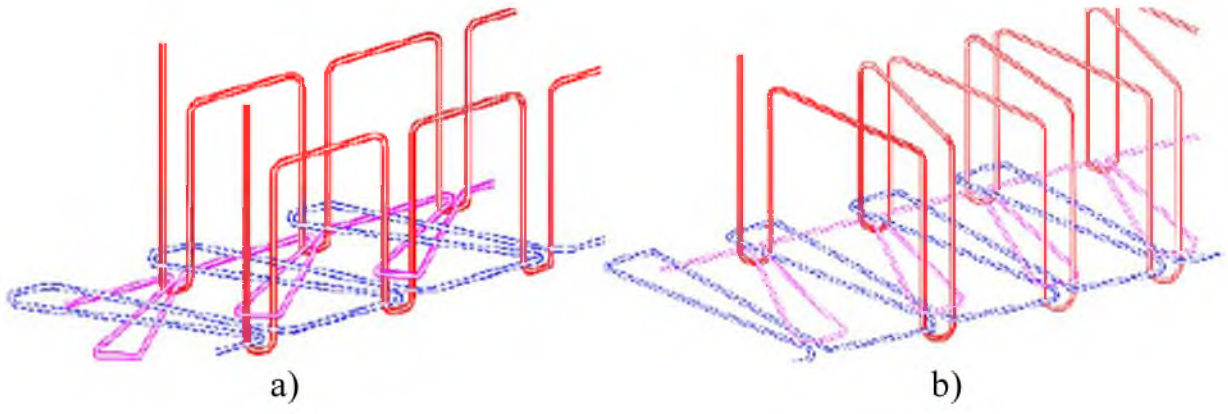

Figure 2 – structure of new type of stitches:
a) four-thread flat chain stitch, b) – triple-thread chain Z-type stitch