ACTIVE THREAD SUPPLY

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Initial Situation

Major international trade exhibitions have shown with unexpected clarity that sewing processes and the large variety of sewing and embroidery machines occupy a dominant position in the textile sector. Main criteria for the use of sewing and embroidery include improved variability, increased productivity, and high quality assurance.
The design and function of thread feeding device components - such as thread take-up and thread brakes - do not meet the current conditions of sewing and embroidering processes characterized by frequent changes in operation, and cannot be adapted to the frequent changes in thread feeding requirements.

Research target

This research project is aimed at making a contribution to the development, design, manufacture and testing of components of thread guiding systems used on sewing and embroidery machines. Efforts were undertaken to create a versatile thread supply system and develop thread brakes featuring reproducible braking force settings to meet current process requirements including fast changes of technical and technological conditions in thread metering, as well as changes of thread tensile strengths in sewing and, particularly, embroidering processes.

Research results

Research efforts were preceded by in-depth patent search work, problem analyses, and a number of investigations by measurement showing the complexity of the subject of examination. Preliminary work was performed in terms of stitch formation, thread running areas, and calculation of force acting inside the thread. Investigations by measurement focussed on the determination of friction values, elasticity moduli, and thread tensile force-strain diagrams showing highly differing parameters and properties for typical embroidery and sewing threads. Hence the necessity to adapt thread feeding system components - such as thread take-up and thread brakes - to the changes occurring in the technological conditions of sewing and/or embroidering processes, including changes of materials to be sewn or embroidered, changes of sewing or embroidery thread, and pattern changes (stitch length, stitch type, stitch direction).

Based on comprehensive, detailed and systematic investigations, various solution principles were established, applied in design work and investigated through measurements. Thread take-up systems and thread brakes are considered to be closely connected elements of high priority.

Bearing in mind the necessity of creating a threading process open to automation, various versions of a rocking thread take-up were designed, manufactured, and tested in trial installations. For testing purposes, driving was performed by means of stepping motors reaching their performance limits when running on long paths. Open thread guides have proved to be unsuitable. Basically, closed thread guides may be used with rocking thread take-up systems in automated systems.

Comprehensive investigations by measurement show that positive thread feeding systems based on roller systems are suitable for embroidery machines. A laboratory prototype provided by our project partner will be improved in design, in close cooperation with the latter, and will thus be prepared for industrial exploitation. It was found that a positive thread supply system is basically suitable for applications under this project.
Thread brakes developed under this project, used with stepping motors and intermediate gear stages, are highly suitable for regulating duties which do not require major time-related

conditions, such as change of material to be embroidered or change of embroidery thread, or for regulating duties implying minor changes of force from one stitch to the other.

It was found that an indirect-action thread brake designed according to the know-how of Cetex gGmbH and using a magnetorheological effect in connection with a double roller system for pulling the thread is unsuitable for discontinuous sewing and embroidering processes.

DC magnets are investigated to find out whether they may be used on thread brakes. Non-linear forces, bouncing, and a relatively high armature mass are limiting their dynamic properties as well as possible applications as fast-action thread brakes adjustable at any stitch. For this reason, state-of-the-art Voice-Coil motors were included in our investigations. Based on this type of motor, a thread brake laboratory prototype is being designed and tested. Proof is furnished that Voice-Coil motors are basically suitable for fast-action regulating processes taking place in pattern changes.
The work under this project lays the foundation for an innovative thread braking system. This development work should be continued.

Application and economic advantages

The know-how gained in investigating the subject of this project allows for the further target-oriented optimization of positive roller-type thread feeding systems. It is planned to introduce the system at our project partner's end in the shortest possible time.

The studies performed under the research project have shown that further investigations into the whole range of components involved in thread guiding systems should be carried out in close connection with the testing of embroidery applications and the acquisition of additional scientific know-how.

Future work should be primarily aimed at the continued development of a controlled thread brake based on Voice-Coil motors.

Figure 1: Motor-controlled rocking thread take-up system

The above-mentioned solutions are innovative improvements over traditional methods. They may be employed on embroidery and sewing machines as well as in embroidery systems with automated thread change being developed and as known from existing literature and patents. The solutions suggested provide for an improved adaptation of production systems to embroidering processes and continuously varying embroidery parameters. Manual adjustments may thus become superfluous, and the quality of the final product may be improved.

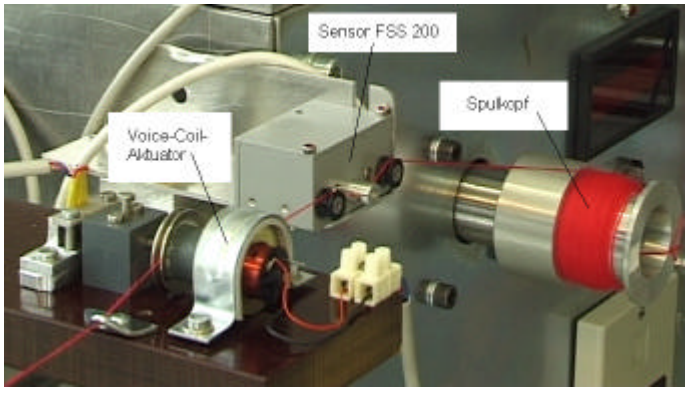

Figure 2: Thread break on the basis of a Voice-coil motor at the test stand