ENERGY SAVING MOTORS FOR SEWING MACHINES

Ineta Nemeša[1*]

[1] Tehnički fakultet "Mihajlo Pupin", Univerzitet u Novom Sadu,
[*] e-mail: inetavil@gmail.com

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Abstract: *During the current year the costs of natural gas has raised about 10 times, electricity prices have increased the similar dramatic way. However, textile industry still widely uses old generation machinery which consumes a lot of energy. New sewing machines in the market are available with two kinds of motors - traditional clutch motors and advanced servo motors. The old type clutch motors use maximum energy all the working day while the machine is switched on. The energy consumption of the servo motors depends on sewing speed and time. When the sewing process is stopped, servo motors operate in stand-by mode. Servo motors ensure to the sewing machine up to 70% less energy consumption than traditional clutch motors. They also ensure 15-30% higher work efficiency. The servo motors for sewing machines are widely available in the marker. The replacement of clutch motors to servo motors on the sewing machines is not complicated process.*

Keywords: energy crisis, sewing machine, clutch motor, servo motor, direct drive motor.

MOTORI ZA ŠIVAĆE MAŠINE KOJI ŠTEDE ENERGIJU

Apstrakt: *Tokom ove godine cene prirodnog gasa su porasle oko 10 puta, cene električne energije su se promenile na sličan, dramatičan način. Međutim, tekstilna industrija i dalje puno koristi mašine starije generacije koje troše mnogo energije. Nove šivaće mašine na tržištu su dostupne sa dve vrste motora - tradicionalnim motorima sa kvačilom i naprednim servo motorima. Motori sa kvačilom starog tipa koriste maksimalno energiju tokom celog radnog dana dok je mašina uključena. Potrošnja energije servo motora zavisi od brzine i vremena šivenja. Kada se proces šivenja zaustavi, servo motori prelaze u režim mirovanja. Mašine sa servo motorima troše do 75% manje energije od mašina sa motorima sa kvačilom. One takođe odezbeđuju 15-30% veću efikastnost rada. Servo motori za šivaće mašine su široko dostupni na tržistu. Zamena motora sa kvačilom na servo motor nije komplikovan proces.*

Ključne reči: energestka kriza, mašina za šivenje, motor sa kvačilom, servo motor, motor direktnog pogona.

1. INTRODUCTION

Energy crisis in Europe lasts already two years. It started in 2021 - at the end of COVID-19 pandemic [1]. Then, after economical lock-down, demand for energy increased seriously. The same time, significant negative climate changes requested to start redesigning of power markets for use of wind and solar energy and, as well, to reduce electricity consumption [1,2,3]. Since Russian military actions in Ukraine and sharp reduction of natural gas supplies in Europe, the energy crisis has even worsened. Natural gas, which is currently used to generate electricity the most often, now costs about 10 times more than one year ago. As the result, electricity prices, tied to the price of gas, have raised the similar dramatic way [4].

To stop recent rise of the electricity prices and with it to support households and businesses, many countries have proposed to reduce electricity demand, and with it to reduce the costs of electricity for consumers. So, countries of EU have a target to reduce total electricity consumption by 10% in regular hours and by 5% in peak hours [5] during this winter.

2. ENERGY CRISIS IN A SEWING DEPARTMENT

As in many industries, also in textile industry different generation machinery is used in manufacturing processes. However, older generation equipment ensures lower work efficiency and productivity, usually it also consumes much more energy. This fact was not

so critical before the energy crisis started. Now, this disadvantage has become the same painful as other problems connected to long time used old machinery in sewing factories.

To reduce energy consumption and to keep product prices low, several brands of the fast fashion business model have made already critical decisions - they have simplified technological process and reduced energy very much consuming finishing operations (ironing, pressing) for their goods. However, this decision can be effective and accepted by consumers only for very short time. It leads to serious quality problems to ready goods and cannot be solution for long term business in the fashion industry. Is there any other possibility to stabilize situation not only for the current critical year, but also for longer time period? Obliviously electricity prices will not be the same low again many years, maybe never.

Yes, there is. During the last decade the producers of sewing equipment offer their industrial sewing machines with two kinds of motors - clutch and servo motors. The clutch motors are well-known in industry already long time. The servo motors are new kind of motors which are used to improve stitching quality, work conditions and productivity, as well as, to ensure lower total energy consumption for sewing enterprises.

3. CLUTCH MOTORS

Clutch motors (see Figure 1) consist of three parts: tri-phase induction motor, a clutch and a belt pulley. A V-belt connects the motor with the main shaft of the machine. During the work process clutch motors reach high speed in very short time - only in few seconds. After the maximal speed is reached, it is kept all the time while the motor is switched on. However, during a sewing process the machine has to be speeded up or slowed down, even stopped when it is necessary. Changing sharply stitching direction an operator has to move the main shaft of the machine manually to created few very precise stitches. However, while it is done, the clutch motor is still running u full power.

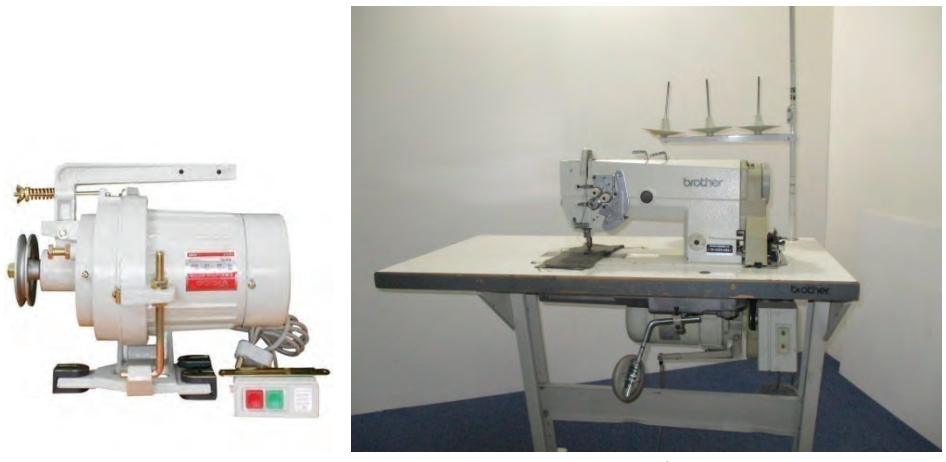
All the working day round the clutch motor consumes maximal amount of energy:

- during stitching process,
- during moving and positioning of processed components,
- during necessary short brakes in sewing process.

These motors also use to heat up and then they use even more energy. Because of worn out parts or bad lubrication they can get overloaded and again use extra energy. Besides, it is known fact that *the needle time* - the time when the seam is stitched by moving needle - is only about 3th part of the all working time. It means that the energy losses using a sewing machine with the clutch motor are very much serious. The clutch motors are preferable for long and simple seam stitching, like overlock seams when sewing speed is high and needle running time is maximal. They are not efficient but can be acceptable for heavy, hard to sew fabric processing as the clutch motors are very powerful [6,7].

4. SERVO MOTORS

The small and compact ***servo motor*** can be fixed on the sewing machine in two different ways. It can be placed under the table as a clutch motor, or it can be fixed directly to the main shaft of a machine. The advanced sewing machines are already produced to-



a b

Figure 1: Clutch motor (a) and clutch motor fixed on a sewing machine (b)
Slika 1: Motor sa kvačilom (a) i motor sa kvačilom montiran na šivaću mašinu (b)

Figure 2: Lockstitch machine JUKI DDL 8700 with Direct Drive motor
Slika 2: Motor direktnog pogona na mašine zrnastih uboda JUKI DDL 8700

gether with their servo motors which are fixed to the machine directly [6] (see Figure 2). This kind of servo motors are called a ***direct-drive motors*** as there is no need for a belt to couple a motor with a sewing machine. Because of this reason the power created by the motor reaches the main shaft of a machine directly not creating noise, vibration and energy losses [7,8,9].

Using a servo motor and several additional components, the machine can work with pre-selected start, stop speeds and other necessary stitching speeds in accordance to the specific requirements of a seam.

While the clutch motors are running in full power all working hours of the machine, the energy consumption of the servo motors depends on their running speed:

- the maximum energy is consumed only in maximum speeds of the machine,
- stitching at the half speed, the motor consumes energy at half rate;
- stopping sewing process, a servo motor operates in stand-by mode and uses only 1W energy!

Above mentioned advantages of the servo motors ensure 65-70% less energy consume comparing with clutch motors [9,10,11].

5. ADDITIONAL BENEFITS USING A SEWING MACHINE WITH A SERVO MOTOR

On new generation sewing machines a servo motor is used together with a synchronizer. Then other additional devices are mounted on the machine to ensure: automatic positioning of a needle, lifting of a presser foot, thread cutting, back tacking or back latching. Using the synchronizer the start and end speed of the stitching process also can be determined and kept for every specific sewing operation. The additional devices mounted on the advanced sewing machine reduce operator's fatigue during working day, help to keep operator's full attention to the stitching process, and with it, increase stitching quality and work process productivity.

Advantages of sewing machines with servo motors comparing to the machines with clutch motors are following [12]:

- ***65-80% less energy consumption***;
- 15-30% higher work efficiency,
- 20%~30% higher labor efficiency;
- better work conditions for an operator;
- reduced noise level,
- no maintenance for a servo motor as it does not have parts to wear out or adjust;
- servo motor is light weight (only 5-15kg).

6. REPLACEMENT OF A CLUTCH MOTOR WITH A SERVO MOTOR

Clutch motors can be easy replaced with servo motors to continue sewing process by the same sewing machine in much more efficient way (see Figure 3), [13].

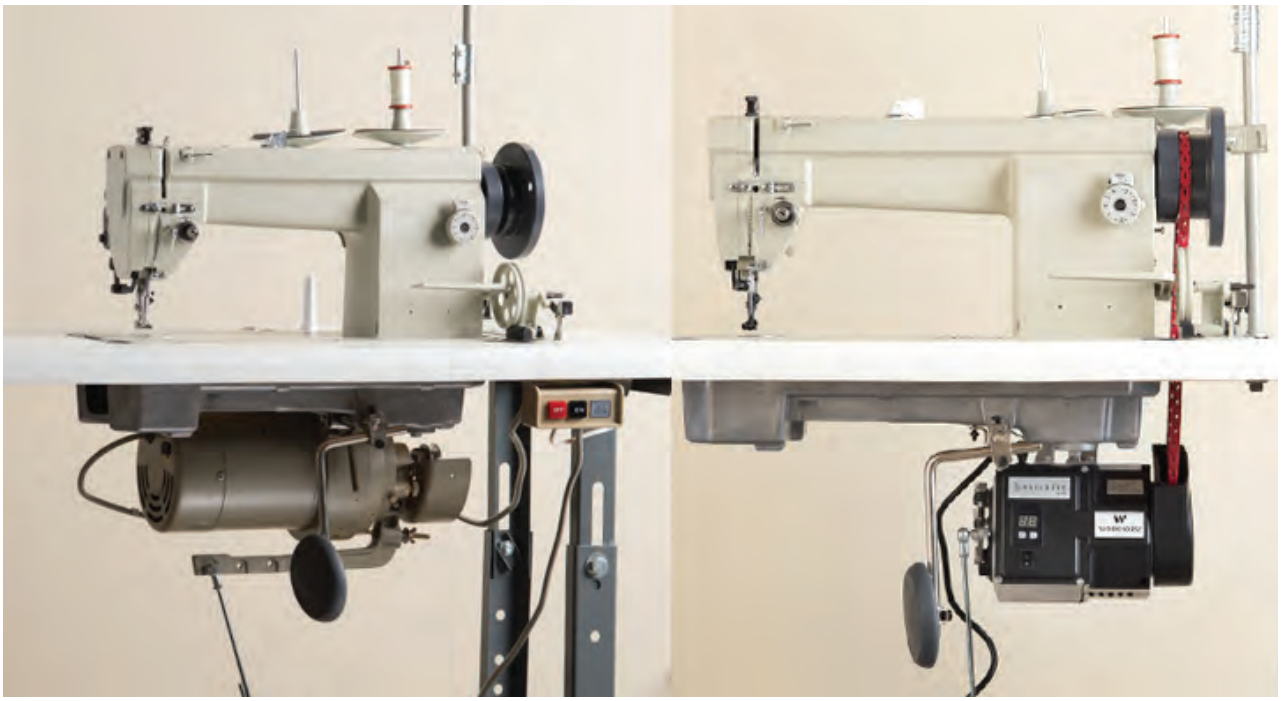


Figure 3: Industrial sewing machine with a clutch motor (a) and a servo motor (b).
Slika 3: Industrijska mašina za šivenje sa motorom sa kvačilom (a) i sa servo motorom (b).

a b

Figure 4: Servo motor (a) and direct drive motor (b)
Slika 4: Servo motor (a) i motor direktnog pogona (b)

Two kind of servo motors are available in the marker:

- the servo motors which have to be placed under the table the same ways as clutch motors using a belt to connect the motor with a machine (see Figure 4.a).
- direct drive servo motors which can be fixed to a sewing machine directly (see Figure 4.b)

The servo motors can be mounted on different kind of lockstitch and chainstitch sewing machines. The work process is not complicated and do not take a lot of time, it can be performed by a mechanic of a sewing line doing regular service to the machines. There are many textual and video instructions available in Internet which tells how to replace a clutch motor with a servo or a direct drive motor. The price of the available servo motors for sewing machines are 100-300$.

7. CONCLUSIONS

Replacing clutch motors of the sewing machines with servo motors, garment producers can reduce their energy consumption seriously and with it save their businesses in current energy crisis situation. The

servo motors will also ensure higher quality and productivity of the sewing process. Reduced electricity bills and raised work productivity will help to keep garment prices stable and will not rise them significantly in the situation when garment consumers are not ready to pay more because of their own problems connected with the current energy crisis.

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