

ADVANCED LUBRICATION SYSTEMS FOR INDUSTRIAL SEWING MACHINES

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Abstract: *The article describes lubrication systems used by advanced industrial sewing machines. The most part of the sewing machines use to be lubricated in automated way. The automated and centralized lubrication system delivers controlled and minimal amount of a liquid lubricant to multiple wear locations in a machine while the machine is operating. To avoid oil leakage and contamination of the workpiece with the lubricant, the machines use to have a sealed needle bars which close the space between stationary and moving components of the machine. Some parts of the machine can be self-lubricating. There are made from metals: bronze, iron or plastic with high porosity and impregnated with a lubricant. The lubricant use to be: oil, graphite, Teflon (PTFE), Diamond Like Carbon (DLC). Many companies are developing so called minimal lubrication machines, semi-dry head and dry head sewing machines. The minimal lubrication machines use a sealed needle bar and a sealed type oil tank. For the hook section of the machine, the standard lubrication method is employed. The needle bar mechanism of the semi-dry machine is dry type and does not require any lubrication. It is coated with diamond-like carbon or Teflon. The hook lubrication of the machine is performed automatically. The most part of the available advanced sewing machines are semi-dry head and minimal lubrication machines. The mechanisms of a dry head sewing machine does not require any lubrication - they can work fully dry.*

Keywords: *industrial sewing machines, lubrication, self-lubricating components, sealed needle bar, semi-dry sewing machines*

INTRODUCTION

The article is developed to describe lubrication systems used by advanced industrial sewing machines. All industrial sewing machines require regular basic maintenance – cleaning and lubrication. The lubrication is the application of oily or greasy substances, to moving surfaces of the machine to reduce their friction and wear [1]. Avoiding direct metal-to-metal contact, the components are protected against wear and can last longer. Beyond friction reduction, lubricants also protect metal parts from corrosion, provide heat and contamination control [2].

Manual lubrication is traditional lubrication method used in sewing factories. However, this method has several serious disadvantages: it increases machine downtime and maintenance costs, as well as, cannot ensure perfect dosing of the lubricant. The uneven lubrication use to lead to serious problems. Insufficient lubrication is the reason of premature wear and contamination of the mechanisms. Too much lubricant applied increases production costs and can contaminate the manufactured textile products. Manual lubrication is not consistent with today's cost efficiency challenges and pro-active maintenance strategies [3].

Automatic/centralized lubrication is an advanced system that delivers controlled and minimal amount of lubricant to multiple wear locations (metal/metal, metal/brass, ball bearing or metal/plastic) in a machine while the machine is operating. Automatic lubrication forms a constant thin layer between moving machine parts to avoid these parts scraping against each other [3].

SEWING MACHINE LUBRICANTS

Oil is a traditional sewing machine lubricant. As oil has syrup-like fluid consistence, it is good for dozing and delivery to different mechanisms of the machine from a common oil source [4]. Separate parts of the machine can be lubricated with grease (see Fig.1).



Figure 1. Grease (a) sewing machine parts lubricated with the grease (b)

The grease is oil with thickener added to be in semi-fluid or solid structure. Using the grease as a lubricant it is easier to avoid its leakage and to provide seals against contaminants. The grease can remain in an equipment longer and tolerate different conditions. New technologies use also solid lubricants, such as graphite, Teflon, Diamond Like Carbon to coat separate components of the machine and with it make them lubrication free [1].

AUTOMATIC LUBRICATION SYSTEMS

Sewing machines with automatic lubrication system use oil as a lubricant because of its fluid consistence [5]. The oil lubricant flows through special channels/pipes to the mechanisms subjected to abrasion. Special computerized system determines the frequency and the volume of lubricant needed. In automatic lubrication systems the oil use to be distributed by help of:

- **gravity (drip feed system)** - consist of a loosely covered cup or manifold of oil, placed above the lubricated components that meters out the oil at a set intervals,
- **wicks** – machines are equipped with oil sumps or felt oil pads. The oil is distribute by help of cotton wicks (cords/ropes), (see Fig.2).

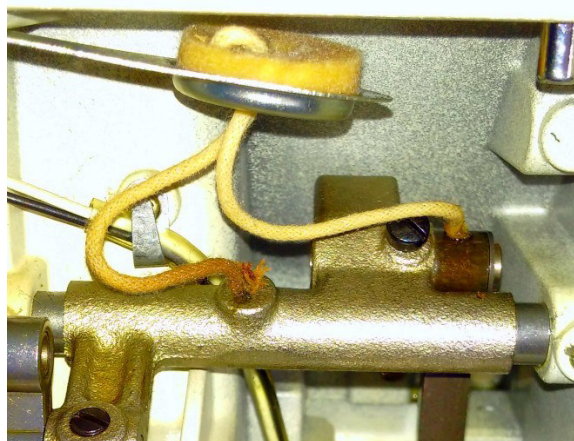


Figure 2. Felt oil pad and cotton wicks to distribute the oil

- **splash** – the oil externally splashes on the certain machine's parts. It is shielded by a frame, oil recovery mechanism and automatic oil circulation mechanism;
- **pressure(force)** – an external oil pump is added to the machines. The flow or splash of oil is seen through the special windows or bubbles which indicate a good oil pressure in the machine.

The most often the oil use to be distributed by help of an external oil pump which is added to the machine. The flow or splash of oil is seen through the special *sight window or bubble* on the top of the machines (see Fig.3). It indicates good oil pressure in the machine.



Figure 3. Sight window to see a flow or splash of oil

The system may also incorporate a suction/vacuum oil return system, operated by the same pump and a filter system to clean used oil and return for use again.

To improve lubrication of machines moving parts and avoid fabric contamination because of accidental oil leakage, advanced machines use sealed parts of the machine, self-lubricating components or specially coated components.

Sealed parts of the sewing machine

Sewing machines use to have a **sealed needle bar** to close the space between machine's stationary and moving components and avoid oil leakage (see Fig.4). The minimal amount of oil is locked inside the fully closed/covered needle bar mechanism. By help of vacuum oil return system the oil is delivered to the needle bar and return to the machine's lubrication system during the work process [6].

To prevent contamination of oil in the lubrication system, instead of traditional oil sump advanced machines use to be equipped with **sealed (dry) oil pan/tank** - a small closed container for oil storage integrated into the machine's head. The sealed oil pan avoid oil leakage and its mixing with ambient dust, as well as, ensures lower oil consumption.

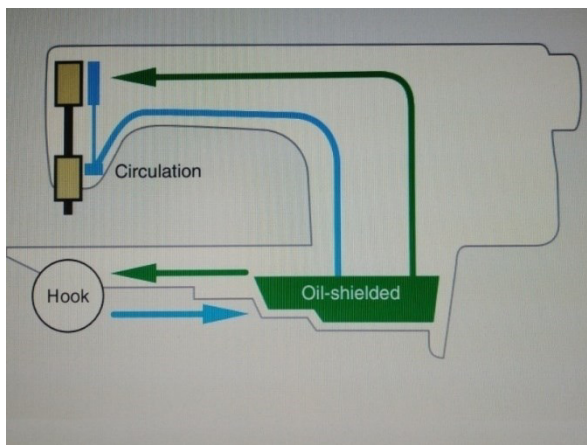


Figure 4. Lubrication system of lockstitch machine JUKI DDL-900A with a sealed needle bar and a sealed oil pan

Dry head of a machine

Many companies are developing so called "semi dry head" and "dry head" sewing machines. It means that the most important drive units of the machine's head - a needle bar, a presser foot bar, bearings do not require lubrication - they can work dry. To reduce friction not using external lubrication, special surface treatments are applied to the major drive units of the machines.

Self-lubricating components

The self-lubricating components (such as, bushes in bearings) are made from metals: bronze, or iron with high porosity (20-25% in volume) or plastic impregnated with a lubricant. The lubricant provides a constant lubrication where metal/metal, metal/brass, ball bearing or metal/plastic meet in the machine. The system does not need any additional external lubricants certain period of time - from the warranty period of the machine up to its guaranteed lifetime (15 years).

Different liquid or solid lubricants are used to manufacture *self-lubricating components*:

- **oil** - the porous metal component is soaked in lightweight oil. The oil gets drawn to the component pores and surface. During the work process of a sewing machine the oil creates a lubricating layer between two surfaces which use to make friction. The oil impregnation can be used also for plastic, such as, nylon components. After this treatment the surface becomes slippery and have low friction coefficient;
- **graphite** - graphite as a solid lubricant is used to treat bronze components. Solid plugs of graphite are inserted into pores of the bronze. The graphite provides lubrication as long as it remains;
- **teflon (PTFE - polytetrafluoroethylene)** - teflon can be used to coat the metal surface in several ways. It can be dusted onto the bearing as a powder, added to a mixture and sprayed onto bearings where it adheres, or it can be part of a liquid or grease compound applied to bearings. By help of these methods a thin layer of Teflon is created on a the component surface;
- **Diamond Like Carbon (DLC)** - components coated with DLC become very durable and their surfaces needs much less lubrication - only ~10% of oil used for conventionally manufactured components.

Oil and grease are traditional lubricants. Solid lubricants are used in circumstances where oil and grease are unsuitable. Advanced sewing machines use to have: bearings soaked with oil or grease, needle bars, presser foot bars, hooks coated with DLC, hooks coated with PTFE (see Fig. 5).

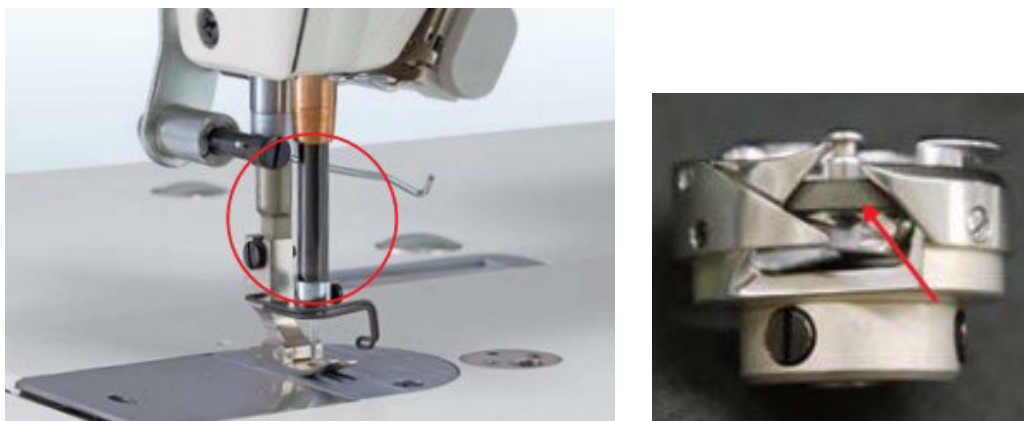


Figure 5. Needle bar finished with a special surface treatment (a), and a hook with a lace from special plastic (b) on Juki DDL-9000

Depending on lubrication principles and specially treated components, sewing machines use to be promoted as: *machines with minimal lubrication, semi-dry head machines, dry head machines.*

Minimal lubrication

The needle bar and thread take-up components are lubricated with the minimum required quantity of oil. The machine can have the sealed needle bar and a sealed type oil pan/ tank. For the machine's hook section, the standard lubrication method is employed. The closed and shortened lubrication system use to be divided in two sections: first section lubricates hook, second section lubricates other moving parts which need the lubricant (see Fig. 6).

Minimal lubrication system prevents oil from being dispersed on sewing area and with it fabric staining during sewing, as well as, reduces oil consumption.

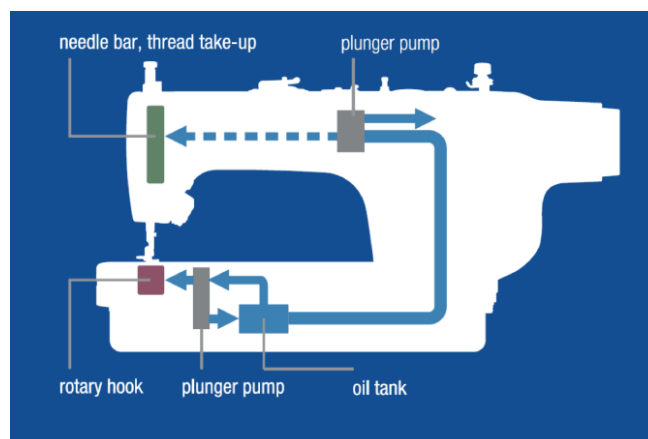


Figure 6. Minimal lubrication system on Brother S-7100A

Semi-dry head

The needle bar mechanism is "*dry type*" and does not require any lubrication. It is coated with diamond-like carbon (DLC) or teflon (PTFE). The machine can also use sealed and maintenance free bearings. The hook lubrication is performed automatically.

The machine may be equipped with oil filtration system. Then the oil dropped from the hook into the under-cover is filtered to remove dirt and dust and is then returned to the oil tank (see Fig.7).

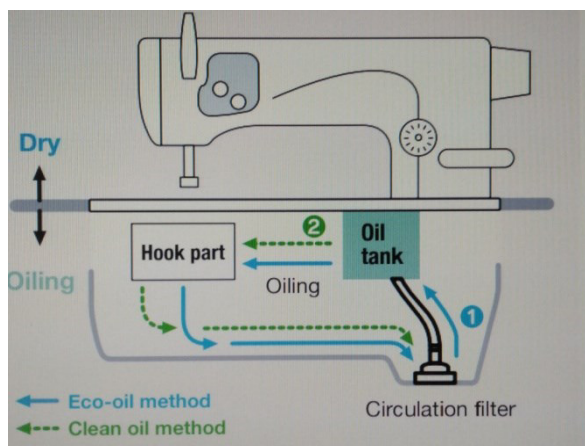


Figure 7. Semi-dry head machine with oil filtration system - eco oil method offered by Juki

Fully dry head

The section around a needle bar, a thread take-up lever and a hook does not need to be lubricated (se Fig.8). Grease-filled bearings with long non-service period are used for the sections requiring bearings.

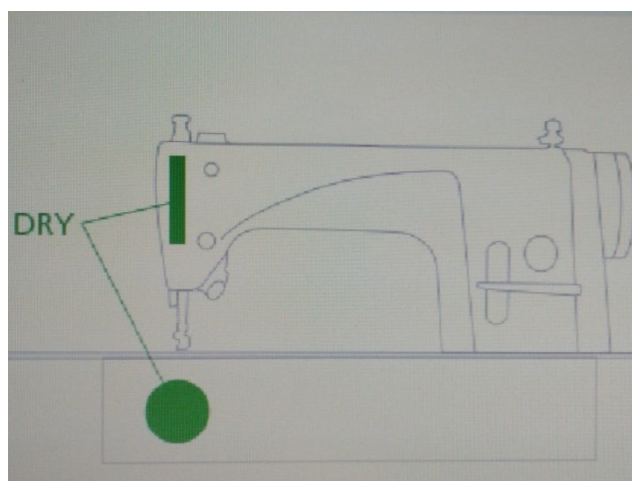


Figure 8. Dry head system sewing machine by Juki

Till now only JUKI DDL-9000BDS is announced as a fully dry head lockstitch sewing machine [7]. All other machines with improved wear parts are promoted as minimal lubrication or semi-dry head machines. There is also no strict border in between meanings a *minimal lubrication machine* and a *semi-dry head machine*. In different brand websites the machines with the same or similar lubrication principles use to be added to one or another group.

Have to be added that all advanced treatment methods which are currently used to get lubrication free parts of the machine (impregnation with a lubricant, coating with DLC) cannot create so called fully maintenance free, or lubed for life components:

- The oil dissipates and ages over time. It has to be replenished or new components fixed in the machine.
- The graphite and Teflon wear out before the end of operational life of the metal components and the machine in which they are used.

By help of these new technologies: machine's lubrication is minimized or simplified; contamination of processed fabric with the lubricant is avoided; non service time of wear parts of the machine is increased.

CONCLUSIONS

The manual lubrication cannot ensure qualitative oiling of the moving part of the sewing machine and efficient work process in a sewing line. Often processed textile goods get contaminated with the too much oil applied. The automatic lubrication systems have replaced traditionally many decades used manual lubrication methods. In nowadays all type of advanced high speed industrial sewing machines use automatic lubrication systems. They can delivery correct amount of oil to all moving parts of the sewing machine in automated way. They help to reduce sewing machine downtime, extended sewing machine life, reduce consumption of the lubricant, reduce maintenance costs, create healthier work conditions to the workers, ensure environmental improvements. The most part of advanced sewing machines are minimal lubrication or semi-dry type machine. They are equipped with sealed or specially coated components. The development of fully dry head sewing machines are still technology of the future. Advanced treatment methods which are currently used to get lubrication free parts of the machine cannot create fully maintenance free, or lubed for life components.

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