

# Milking Machine Using Scotch Yoke Mechanism

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**Abstract**—Modern milking machines extract milk from the dairy cow by applying a vacuum to the teat creating a pressure difference that results in milk flowing from the teat. Vacuum is applied by placing the teat into a cup in which the interior of the cup is subjected to a vacuum. The vacuum must be periodically reduced or removed to provide the teat with a rest period. The rest period is required because the vacuum causes the fluids (blood and other fluids) to accumulate in the teat causing congestion. Modern conventional milking machines attempt to provide this rest period by periodically applying a higher pressure (atmospheric) to the exterior of the cup causing the cup to collapse toward the teat. The typical conventional milking machine will thereby reduce the vacuum level on the teat. The periodic liner action created by the pulsing of higher pressure on the exterior of the liner is provided by pulsates.

**Index Terms**—milking, scotch yoke, vacuum.

## I. INTRODUCTION

The project is about cheapest milking machines for small dairy farmers, and for power starved territories. Dairy mate pedal operated milking machine can be operated by anyone, it also can be easily operated by elderly people, and Dairy mate pedal operated milking machine can be transferred easily from one place to another place because of compact design, lightweight and its simplicity[1].

The milking machine plays an important role on the dairy farm as an efficient means of milking cows; however, it must be remembered that this machine is one of the few devices which has direct contact with living animal tissue. A milking operation which results in discomfort to the cow and is caused by faulty milking equipment or techniques may lead to injury or mastitis. Consequently, before a person attempts to milk cows he/she should thoroughly understand the basic operation of the milking equipment and fully realize the significance of maintaining the equipment in good condition at all times and of employing good milking techniques. This factsheet describes the basic

operations involved to help give a better understanding of milking machines.

The teat cup liner is the only equipment that comes into contact with the cows teats. The continuous vacuum within the liner causes the teat duct (streak canal) to open and the milk to flow because of the pressure difference between the milk in the teat and vacuum. To prevent damage or pain to the teat that would be caused by the continuous vacuum a system called pulsation is used.

## II. SPECIFICATIONS

Milking Capacity	: 14-16 Cows/Hour
Milking Can	: 20 Liters, 304 SS (ISO 9001)
Pulse	: 50-60 cycles/min
Teat liner depth	: 180 mm
Teat cup Dai	: 25-50 mm
Pressure	: 40-50Kpa
Pedal operated, Seating type.	

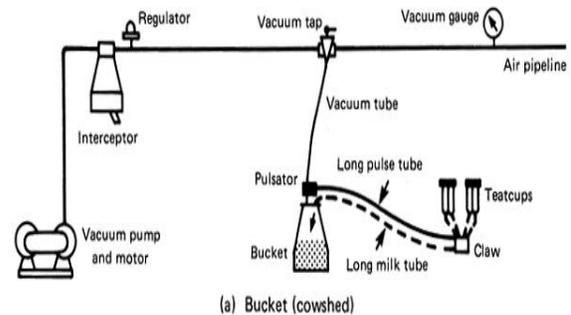


Figure 1. Pedal operated, Seating Type machine setup.

## III. Working

The setup is done as shown in the above Figure 1. The sucking action is created by the vacuum pump which is manually operated and it is connected to the interceptor through vacuum tube. The vacuum pump uses the “SCOTCH YOKE MECHANISM”[2]. Interceptor is used to prevent solid and liquid material from getting sucked into the vacuum pump which may

result in the failure of system. The sucked air pressure is controlled by the regulator. And vacuum tap is used to on and off air from the atmosphere. As we know gauge is used to show pressure difference. The pulsators are the valves that cause the liners to open and close on the teat once each second by connecting the pulsation chamber of the teat cup to vacuum or atmosphere. Due to these sucking action the milk gets released into the teat cups which are connected to teats of cow and they are mounted on claws. The sucked milk go and stores in bucket through milk tube[3].

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The main milking machine factor affecting milk flow rate is the liner vacuum. Raising vacuum levels gives faster milking but also increases strip yields and in practice a compromise level of about half atmospheric pressure is used (i.e. 40-50 KPa, 300-375 mm/Hg). The pulsation characteristics also affect flow. An increased pulsation frequency (rate) gives faster milking but because this greatly increases the air admission in the machine and therefore the required pump capacity it is usual to keep pulsation rates at 50–60 cycles of liner opening and closing per minute. Because milk flow ceases in each pulsation cycle when the liner is collapsed on the teat, faster flow rates are obtained by using a wider pulsation ratio (i.e. ratio of liner open time to liner collapsed time). For udder health reasons the ratios are usually not greater than 70:30. The design of the liner can also affect the flow rate but modern liners tend to have similar flow properties. Narrow bore (<24 mm) liners and those with low tension in the barrel (i.e. not stretched in the teat cup) milk more slowly. The most important characteristic of the performance of a liner is the amount of striping left at the end of milking which is mainly determined by the dimensions and hardness of the mouthpiece. Liner design is largely empirical and

farmers determine the best liners for minimum striping by trial and error.

#### IV. MILK AND AIR SEPARATION

In pipeline milking installations it is necessary to include a method of extracting milk from the vacuum system. A receiver vessel is fitted to act as a milk reservoir and air separator and from this the milk is pumped out. It is made of either glass or stainless steel and may have a capacity of 35 to 160 liters or more depending on the method of cooling and storing the milk. During milking the weight or level of milk in the receiver is used to start the milk pump (releaser). Releaser milk pumps for extracting milk out of the vacuum system are: centrifugal, with capacities of at least 4550 liters per hour, or diaphragm, with capacities of approximately 2000 liters/hr for a single ended pump. Other methods for extracting milk from a vacuum system are double chambered releasers with weight operated mechanical valves and the 'spit chamber' releaser. These do not require electricity and the latter utilizes a pulsating vacuum to alternately open and close flap valves allowing the milk to drain out of the second chamber[4].

In addition to the interceptor for the vacuum pump, a sanitary trap, is fitted in the vacuum pipeline adjacent to the receiver. This is a glass vessel of not less than 3 liters capacity that separates the part of the milking machine through which milk passes from the air system, preventing movement of liquid from one to the other. If milk enters the sanitary trap it is an indication of a fault in the machine. Therefore, it should be mounted within sight of the milker and be fitted with a float ball to shut off the vacuum. The vacuum connection between the sanitary trap and the receiver should slope away from the receiver to the sanitary trap.

#### V. ACTION OF THE MILKING MACHINE IN EACH PULSATION CYCLE

Pulsator connects pulsation chamber to vacuum, liner opens and milk flows.

Pulsator connects pulsation chamber to atmosphere, liner collapses, squeezes the teat duct and prevents milk flow.

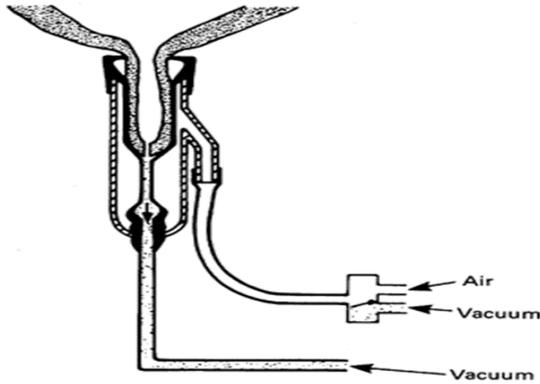


Figure 2. Milking machine setup

### VI. SCOTH YOKE MECHANISM

The to and fro reciprocating motion for the cylinder is given by cycle. The circular motion obtained from the pedals of cycle is converted by using scotch and yoke mechanism [5].

The scotch yoke mechanism is reciprocating motion mechanism, converting the liner motion of a slider into rotational motion, or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. In many internal combustion engine, linear motion is converted into rotational motion by means of a crankshaft, a piston and a rod that connects them. The scotch yoke is considered to be a, more efficient means of producing the rotational motion as it spends more time at the high point of its rotation than a piston and it has fewer parts.

### VII. ADVANTAGES

- Elimination of labour: The farmer is freed from the milking process and associated rigid schedule, and labour is devoted to supervision of animal feeding.
- Production: Milking process two cows can be operated at a time, minimize the time, labour and increase the production.
- Increased milking frequency: Milking frequency is 2.5 times per day, this may result in less stress on the udder and increased comfort for the cow as on less milk is stored. Higher frequency milking increases milk yield per cow.
- Perceived lower stress environment: The proper milking routine will reduce the stress on the stock, which not only improves the health of the animal, but also ensure a higher quality in dairy harvest.

- Droplets: milking till the last drop.
- The process is 3-4 times faster than hand milking.



Figure 3. Pictorial depiction of the ready machine.

### VIII. CONCLUSION

The milking machines that are already present will suck all the teats at the same time, which is harmful or painful to the cow or buffalo. This can be overcome by implementing the scotch yoke mechanism in creating the suction. By using this mechanism the suction for the teats will be created alternatively which will be similar to hand milking and that will be safe for animals.

### REFERENCES

- [1] Bade, R.D., D.J. Reinemann, M. Zucali, P.L. Ruegg, and P.D. Thompson. 2009. Interactions of vacuum, b-phase, and liner compression on milk flow rates in dairy cows. *J. Dairy Sci.* 92:913–921.

- [2] Davis, M.A., D.J. Reinemann, and G.A. Mein. 2001. Development and Testing of a Device to Measure Compressive Teat Load Applied to a Bovine Teat by the Closed Teatcup Liner. ASAE Annual International Meeting, Sacramento, California, July 2001.
- [3] Gomez, S.A., D.J. Reinemann, and P.D. Thompson. 2011. Predicting Liner Performance. Proc. 49th Annual Meeting of NMC, Arlington, VA, January 2011.
- [4] Hamann, J., O. Osteras, M. Maynz, and W. Woyke. 1994. Functional parameters of milking units with regard to teat tissue treatment. Bulletin of the IDF 297:1994, p23-34. ISO 3918:2007. Milking Machine Installations – Vocabulary. International Standards Organisation, Geneva, Switzerland.
- [5] Kochman, A., and S. Little. 2010. The effect of Over-Pressure on teat-end condition. Proc. 48th Annual Meeting of NMC, Albuquerque, NM, USA, p218-219.