CSKMS Student Booklet

Learning about circular sock machines bridges the gap between history, textile art and mechanical engineering. It forces us to slow down, look at the gears, and appreciate the complex labor behind the everyday items we take for granted.

CSKMS Table of Contents

1	History
5	Timeline
7	Glossary
8	Machine Anatomy
9	Manufacturers
10	Safety and Setup
10	How a Stitch is formed
11	How to make a Sock
13	Knitting Gauge
15	Maintenance and Troubleshooting

The Great Sock Problem

Before knitting machines, stockings were knit by hand. They took time to make and those that wore stockings may only have a pair or two. The stockings were darned and patched repeatedly. Queen Elizabeth I of England wore expensive silk stockings. In 1589, Reverend William Lee invented the first knitting machine. He hoped he would be granted a Patent, but the Queen was concerned the knitting machine would take jobs away from the poor hand knitters and refused the patent. The machine knit flat panels that required seams to make socks but this first invention laid the groundwork for later knitting machines.

Going in Circles

In 1816 Marc Brunel (Born in France but moved to Britain) invented the first circular knitting machine that cranked by hand. Instead of knitting a flat sheet, this machine knit a tube. A tube worked for sleeves, pant legs, and socks!

American inventor, Henry Griswold in 1870, improved the design by adding a ribbing attachment. The ribber made the top of the sock stretchy, so it would not fall down the leg. The machine was known as the Griswold machine.

Socks Go to War

Late 1800s circular sock machines were in thousands of homes. Companies like Gearhart and Griswald sold cast-iron machines. They were small enough to clamp onto a kitchen table and provide for a family's sock needs. In World War 1 (1914-1918) the Red Cross distributed thousands of sock machines for volunteers to use at home. Those sock machines were used to crank out one million pairs of socks for the troops. The soldiers needed to change into dry clean socks multiple times per day to prevent trench foot, a fungal infection caused by wet boots.

The Machines Today

After World War II, commercial factories took over sock making. The hand cranked circular sock machines were stored in attics and barns. Many were melted down for scrap metal, but the story did not end there. The antique machines are now highly prized among a community of hobbyists called crankers.150 year old technology is popular again. 3D printers are being used to design

and manufacture brand new circular sock machines. A few manufacturers have redesigned and started producing circular sock machines out of lighter metals and plastics. Fiber artists are using the sock machines to turn their hand dyed wool into high quality socks to sell at local markets.

Timeline of the Circular Sock Machine Development

Year	Event Headline	Historical Impact
1589	**The Stocking Frame Invented**	Rev. William Lee builds a machine to mimic hand-knitting. It knits **flat fabric** that still requires seaming. Queen Elizabeth I denies him a patent, fearing it will put human hand-knitters out of work.
1816	**First Circular Machine Formed**	French engineer Marc Brunel arranges needles in a **circular needle bed**. This breakthrough produces seamless, continuous tubes of fabric—perfect for stockings.
1847	**The Latch Needle Breakthrough**	Matthew Townsend invents the **latch needle**. This makes circular knitting automated, faster, and far more reliable, paving the way for home-use appliances.

1878	**The Ribber Attachment Added**	Henry Griswold introduces a second, horizontal set of needles. This allows the machine to easily knit a **ribbed cuff**, keeping socks from sliding down the leg.
1914	**WWI Trench Warfare Demand**	The Red Cross distributes thousands of hand-cranked CSMs to households. Volunteers use them to crank out over **1 million socks** to save soldiers from "trench foot" during World War I.
1938	**The Nylon Material Revolution**	Synthetics change everything. Heavy wool and silk give way to **blended nylon yarns**, creating durable, elastic, modern socks.

History of the Circular Sock Machine Quiz

Long before modern machines, who invented the very first mechanical knitting machine in 1589?

A) Marc Brunel
B) Eli Whitney
C) Rev. William Lee
D) Thomas Edison

2. What major contribution did Marc Brunel make to the history of knitting?

A) He invented the first mechanical knitting machine.
B) He designed the first computer.
C) He developed the first circular knitting machine.
D) He invented the 3D printer.

3. During World War I, circular sock machines became incredibly important for soldiers. Why were sock machines important during World War I?

A) They were used to knit camouflage uniforms.
B) They helped make bandages and gauze for injured soldiers.
C) They were used to knit messages in code.
D) They rapidly produced warm socks to help prevent trench foot.

4. How are circular sock machines being made or upgraded in the modern era?

A) People are using 3D printing to create custom plastic parts and machines at home.
B) They are no longer used; all socks are made by robots in large factories.
C) They are being converted to run on steam engines.
D) Inventors are building them out of solid gold.

5. What is the main advantage of a circular sock machine compared to traditional hand-knitting?

A) It requires no yarn to work.
B) It knits much faster and creates a seamless tube of fabric.
C) It only knits flat squares.
D) It sews buttons onto the socks automatically.

Glossary

Blocking Setting the stitches by placing the sock on a form after it has been moistened or washed. Let dry. Blocking improves the shape and look of the work.
Bind off You can use a latchkey bind off by starting where the yarn tail is and removing a needle carefully and pulling the yarn tail through, forming a loop, and placing the loop on the next needle. You will then remove the needle with the loop you just added and pull the yarn tail through to form a loop, placing the loop on the next needle. Work around the entire cylinder. Instead of the latch key bind off you could pull the tail through all the needles and pull tight to form a gathered finish.
Bonnet (set up bonnet) A knit bonnet used to start the knitting (equivalent to casting on). Also called a set up bonnet. Could be a metal pronged device. Simple directions for making a cast on bonnet: make a hung hem with a picot edge in the center of the hung hem by moving the yarn over on every other needle. Knit several rows and finish by gathering all the stitches and pull tight. Knot the gathering thread.
BuckleA metal buckle for attaching weights to the knit sock to assist with forming the stitch by putting downward pressure.
Cam Shell The assembly surrounding the cylinder that contains the cams, which guides the needles up and down to create stitches.
Crank Turn the main handle to rotate the cylinder. Moving the handle in a continuous 360-degree motion to knit tubes (leg, foot).
Cuff The top edge of the sock, usually ribbed but could be a hung hem.
Cylinder The main, removable, vertical tube with slots holding the latch needles (e.g., a 60-slot or 72-slot cylinder determines the stitch count).
Cylinder Spring A circular spring that sits in a groove on the outside of the cylinder to hold needles in place.
Fingering weight yarn The type of yarn that is commonly used in making socks. Look for yarn that is around 400–425 yards per 100 grams.
Gauge Number of stitches per inch and how many rows per inch. Remove weights when measuring.
Grafting A method of joining the work to blend with the knit.
Heel Forks Specialized, weighted tools used to hold and control yarn during heel and toe knitting.
Heel Spring A wire spring attached to the cylinder that holds the needles in work during short-row heels and toes.
Hung hem A folded hem produced by knitting a tube and rehanging the cast-on edge onto the needles to knit the layers together.
Kitchener Stitch A grafting technique used to close the toe seamlessly by mimicking a row of knitting.

Lace Lace knitting is formed by moving a stitch off the needles and placing the loop on the next needle to the left or the right depending on the design. This will form a hole and holes can be organized to form a pattern.

Latch Needles The specific type of needle used in machines that have a hinged hook, which closes to form a stitch automatically.

Lower the needle The process of putting a cylinder needle back into work. Do not lower the needle all the way. Push it down, but not all the way down.

Marking the Cylinder Marking the halfway points on the cylinder to ensure the heel and toe are centered and you always start at the same point. Marking the cylinder for the toe/heel width is helpful.

Needle butt The hump on the cylinder or ribber needle

Negative ease A measurement that allows for the natural stretch of knitting

Pick Tool A small hook used for fixing dropped stitches, transferring stitches to the ribber, or making changes by hand.

Pre-heel Section of knitting on the sock between the leg and the heel that improves fit.

Raise the needle Lift the needle out of work. Lift it all the way up so the butt rests against the heel spring. Use a pick tool, as the needles are sharp.

Ribber An optional attachment that sits on top of the cylinder to create ribbed fabric (alternating knit/purl stitches).

Russian join Joining yarn ends. Cross the yarn over, thread the one yarn end on a tapestry needle and weave the yarn back into the same yarn. Repeat with the other yarn end. This creates a smooth yarn join without a knot.

Short Row The method used to create heels and toes, where the machine is cranked back and forth instead of in a full circle.

Standard short rows Short rows are made raising/lowering half of the needles to decrease then increase for heels and toes.

Stockinette stitch A commonly used stitch creating a knit fabric with knit Vs on one side and purl bumps on the back.

Tension Gauge/Dial The adjustment mechanism that controls how tight or loose the stitches are.

V-Cam A component within the cam system that pulls needles down to determine stitch size.

Waste Yarn Scrap yarn used at the beginning and end of a project to make it easier to start and finish without ruining the main piece.

Weights Weights suspended from the knitted tube to ensure consistent tension and proper stitch formation.

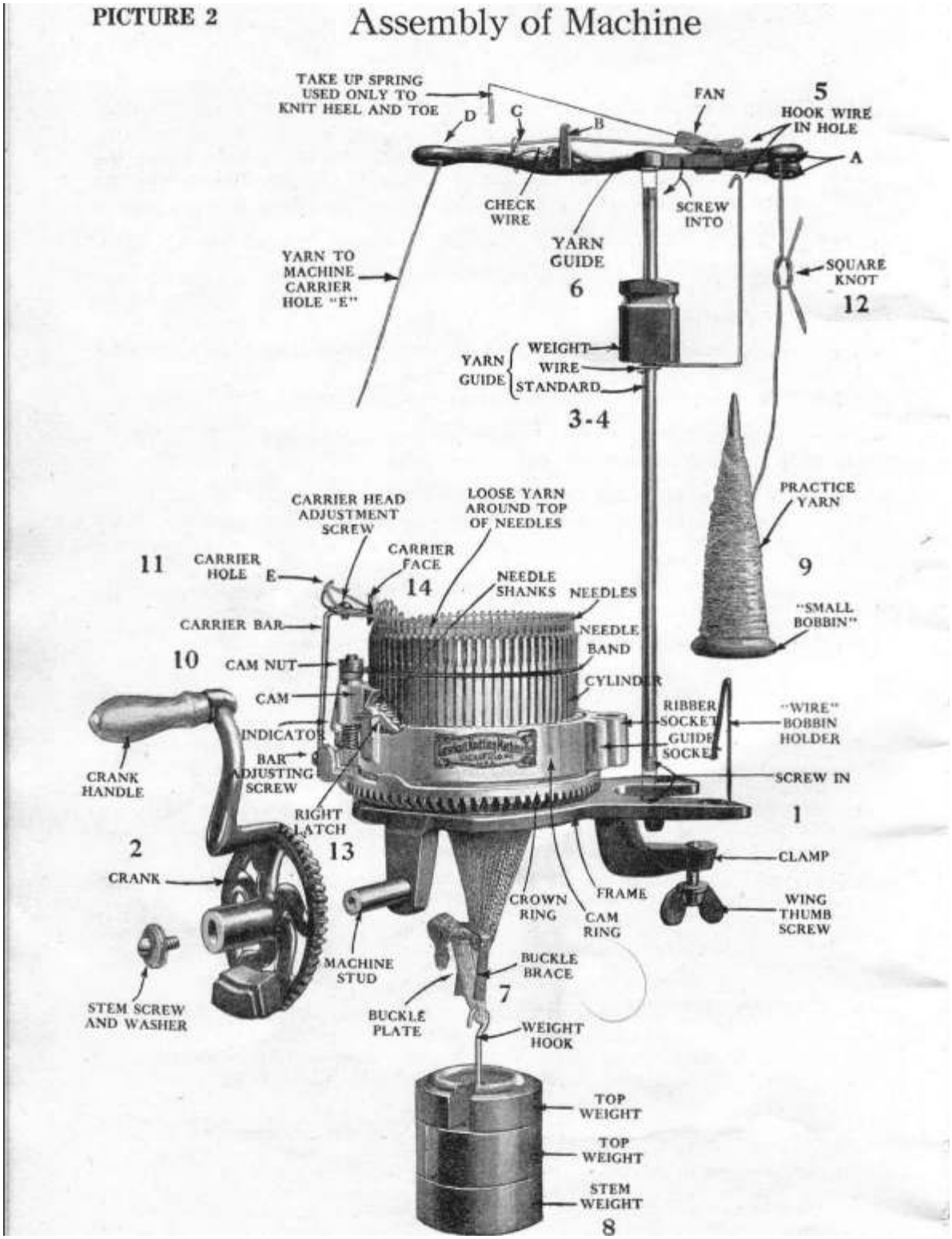
Wool Protein fiber sheared from sheep and other animals, it is breathable, moisture wicking and insulating.

Yarn Guide The guide that feeds the yarn into the needles.

Yarn Mast The vertical rod that holds the yarn cone and guides the yarn down to the machine.

PICTURE 2

Assembly of Machine



Current Manufacturers of Circular Sock machines

Erlbacher Knitting Machine Company
Cape Girardeau, MO, USA
Builds heavy, cast-iron replicas of the early 1900s Gearhart machines, including the "Speedster" and "Bumblebee" packages.

Tru-Knit by Jamie Mayfield
St. Louis, MO, USA
Crafted out of lightweight aluminum and stainless steel. Known for smooth cranking and the "Silver Bullet" yarn feeder that reduces dropped stitches.

Chambord CSM
Compton, Quebec, Canada
Produces the Accuknitter 400, a modern metal machine that is highly prized and backwards-compatible with antique Legare parts.

Lamb Knitting Machine Corporation
Chicopee, MA, USA
Produces the Model LT150, a modern commercial-grade replica of the historic Tuttle circular sock machine.

NZ Autoknitter (NZAK)
Hokitika, New Zealand
Manufactured metal hand cranked hosiery machines.

Dean and Bean's Sock Machines
Cedar Falls, IA, USA
Innovators of highly accessible, uniquely engineered, functional 3D-printed circular sock machines.

Sound Yarn & Fibre Canada
Manufactured entry-level 3D-printed sock machines for budget-conscious knitters.

Antique knitting machines

Gearhart Knitting Machine Co. Clearfield, Pennsylvania
Auto Knitter Hosiery Co. Canada
Creelman Brothers Canada. Money Maker and Banner models
Legara Canada Legare 400 model

Safety and Set up

The Circular sock machine should be securely mounted on a stable table or stand.

Note the pinch points on the machine at the moving gears and the sharp latch needles. Take care when using the machine.

Keep your feet away from the weights used to provide down pressure to the knitting, you would not want them to drop onto your foot.

How a stitch is formed

On a circular sock machine, a stitch is formed through the coordinated movement of latch needles and a yarn carrier.

Feeding: The needle rises, opening its latch, and receives new yarn from the carrier.

Clearing: The needle continues upward until the old loop slides below the open latch onto the needle shank.

Casting Off: The needle is pulled downward by a cam. The old loop slides up, flips the latch closed over the new yarn, and slips completely off the top of the needle.

Drawing: The needle pulls the new yarn down through the old loop, forming a brand-new stitch.

Creating a Sock

To create a sock on a traditional circular sock machine (CSM), cast on with waste yarn, knit the leg and foot in the round, shape the short-row heel and toe using raised needles, and finish by grafting the final open stitches closed.

Cast On and Leg

- **Set up tension and weights**: Thread your yarn through the mast and yarn feeder, and hang your setup bonnet and connect weight to provide downward pull.
- **Cast on with waste yarn**: Knit several rows using waste yarn.
- **Switch to working yarn**: Switch to your main sock yarn, engage the heel spring, and crank the handle to knit 20 rows and hang the hem.
- **Hang the Hem**: Remove the weights and pull up the first row of working yarn and place each stitch onto a needle. Replace weights and knit a round.
- **Knit the leg**: crank the number of rounds desired for the leg.

Heel and Foot

- **Knit the short-row heel**: Raise a specified portion of your needles out of action on one side according to your pattern, then work short rows by decreasing and increasing active needles to form a cupped heel. Attach a heel fork weight for tension.
- **Knit the foot section**: Lower all the needles back down and crank in the round again to knit the foot section.

Toe and Finishing

- **Knit the short-row toe**: Repeat the short-row shaping process (just like the heel) on half of the needles to form the toe pocket.
- **Waste yarn**: attach the waste yarn and knit several rounds.
- **Remove and graft**: Take the sock off the machine by cranking with no yarn in the yarn carrier carefully to prevent stitches from running. then use a tapestry needle to kitchener or graft the remaining live stitches of the toe closed.

Question 1: What should you use to cast on first on a CSM?

- A) Main sock yarn
- B) Waste yarn
- C) Elastic cord
- D) shoelace

Question 2: What items hang inside the cylinder to pull downward?

- A) Setup bonnet and bottom weight
- B) Waste yarn and tapestry needle
- C) mast and main yarn
- D) Heel spring and tension mast

Question 3: How do you shape the short-row heel and toe?

- A) By binding off stitches flat
- B) By decreasing all needles at once
- C) By using raised and lowered needles
- D) By switching back to waste yarn

Question 4: What specific weight is attached during the short-row heel?

- A) Bottom weight
- B) Setup bonnet
- C) Heel fork weight
- D) Cylinder weight

Question 5: How do you finish the final open stitches of the toe?

- A) Sewing a button
- B) Grafting them closed with a tapestry needle
- C) Tying a tight knot in the waste yarn
- D) Melting the yarn ends together

Knitting Gauge Steps to Knit and Measure a Swatch

- **Knit waste yarn:** Crank several rows of waste yarn.
- **Knit working rows:** Switch to your working yarn and crank 50 or more rows.
- **Let the fabric rest:** Remove the tube from the machine and let the knitted fabric relax completely before measuring. (Consider washing this sample to get a more accurate measurement of the final sock. You would need to secure the edges of the swatch before washing.)
- **Mark and measure:** Lay a ruler flat on the swatch and mark a section using yarn or pins to mark a square. You can use a 2, 3 inch or 4 inch size square.

Calculating the Math

- **Stitch gauge (width):** Count the number of stitches (number of V), then divide by the number of inches.
- **Row gauge (length):** Count the rows, then divide by the number of inches.
- **Note settings:** Record your cylinder size, yarn type, and the tension/cam setting, so you can replicate it when you make your sock.
- **Negative ease**: The measurements can be used to size a sock correctly to the foot. Note that socks need negative ease to form to the foot. The sock should be about a half inch narrower and half inch shorter.

Knitting Math: Calculating Row and Stitch Gauge quiz

1. You knit a square sample to check your gauge and measure 16 stitches in a 4-inch width. How many stitches per inch is this?

A) 3 stitches per inch
B) 5 stitches per inch
C) 4 stitches per inch
D) 6 stitches per inch

2. On the same sample, you measure 20 rows in a 4-inch height. How many rows per inch is your row gauge?

A) 4 rows per inch
B) 5 rows per inch
C) 6 rows per inch
D) 8 rows per inch

3. Your stitch gauge is 10 stitches per inch. If you want to knit a sock that is 6 inches around, what size cylinder do you need?

A) 100 slot cylinder
B) 80 slot cylinder
C) 72 slot cylinder
D) 60 slot cylinder

4. Your row gauge is 8 rows per inch. You want your sock leg to be exactly 6 inches long. How many total rows do you need to knit?

A) 56 rows
B) 86 rows
C) 48 rows
D) 60 rows

5. A pattern requires 72 stitches for the sock circumference . Your stitch gauge is 9 stitches per inch. What is the circumference in inches?

A) 8 inches
B) 4 inches
C) 10 inches
D) 7 inches

Troubleshooting

Check that all latches on the needles are open when knitting. You will need to check often. Consider aligning the yarn carrier close to the needles to lift the latches open.

If you drop a stitch you can latch it back up by sliding the latch hook tool between the cylinder and the knitting. Catch the last knit stitch and mimic the action of the latch knitting by sliding the stitch up the tool stem and catching the next yarn bar in the latch, pull through and repeat until all stitches are knit, place the stitch on the needle.(If you need to latch up a purl stitch start from the inside of the knitting.)

If the yarn travels up your needles or does not knit, then you need more downward pressure, so add or adjust the weights.

If the crank is difficult to turn, check that the yarn is feeding into the machine freely. Using cones of yarn helps to feed the yarn smoothly.

If the crank will not turn, check the needles to see if they are jammed on the flipper cam. You can wiggle needles or move the yarn carrier back slightly to unjam. You could have a needle in backwards.

If the needles will not raise then check the flipper cam system and see if the cam edge is against the bottom of the cylinder to pick up the needles, if not you can raise a few needles to allow the space needed to lower the cam.

How to maintain a Circular Sock knitting Machine

First you need to keep your machine in a clean dry environment to prevent rust and you need to lubricate often. Placed oil on the cylinder spring all the way around. Place oil on the cam area and the tappet plate to reduce friction and ensure the smooth operation of your knitting machine. Clean lint from your machine regularly using a soft brush or cloth. Note: if you have a printed machine use PTFE spray instead of oil.

Question 1: What should you do to check that all latches on the needles are open?

- A) Close them manually before every row.
- B) Align the yarn carrier close to the needles to lift the latches open.
- C) Add oil to the cylinder spring.
- D) Pull every needle out of the cylinder.

Question 2: Where do you slide the latch hook tool when you drop a stitch on regular knitting?

- A) From the inside of the knitting.
- B) Directly over the top of the flipper cam.
- C) Between the cylinder and the knitting.
- D) Underneath the tappet plate.

Question 3: What should you do if the crank is difficult to turn?

- A) Remove all downward weights.
- B) Check that the yarn feeds into the machine freely.
- C) Put the needles in backwards.
- D) Slide the yarn taller

Question 4: What might cause the crank to not turn at all?

- A) Needles are jammed on the flipper cam or a needle is in backwards.
- B) The environment is too clean and dry.
- C) The yarn cones are feeding too smoothly.
- D) The latches are all open.

Question 5: Where should you place oil on the machine?

- A) Only on the yarn carrier and yarn bars.
- B) On the handle of the latch hook tool.
- C) On the cylinder spring all the way around, the cam area, and the tappet plate.
- D) Directly onto the flipper cam edge only when it jams.