# Domestic Sewing Machine Attachments

**Richard Watkins**



The emphasis on Singer machines is the result of what I have available to me, and because Singer published many documents that are readily available on the Internet.

Of course, not all attachments are described in this article, but I think that enough variety is covered so that the owner of another attachment will be able to understand how it works.

I would like to thank Ericka Officer for proof-reading my article and providing me with many suggestions and comments.

Also, my thanks go to Steven Heeter, Ericka Officer, John Stuart and Wolfegang's Collectibles for giving permission to reproduce photographs; Megan Mills for providing me with a sewing machine manual and other information; and members of victoriansweatshop.com and quiltingboard.com for their help.

In addition, my partner Georgina was a willing participant, happily sitting at her treadle sewing machine while I watched and tried to understand the workings of this complex machine; at the moment she is using a Janome foot-holder and presser-foot on it. And she bought a buttonhole attachment from an opportunity shop that was useless for her but enlightening for me, and I hope you.

# Introduction

Older mechanical sewing machines can perform only one action, to make stitches of uniform length in a straight line. The most interesting of their few interchangeable parts are the *presser-feet* and *attachments*. With the normal presser-foot the machine can only sew in a straight line. However, there are attachments that adapt the sewing machine to sew in sophisticated ways.

Although there are many instructions on how to *use* presser-feet and attachments, I have found no explanations of how they *work*, even though they are probably the most important features of sewing machines. This is because they enable the machine to perform complex tasks easily, tasks that would otherwise be very difficult and time consuming.

For example, one problem with material is that the cut edge of it will fray. And so the second most important activity of the user, behind joining pieces of material together in a straight line, is to *hem*; that is, to fold the edge of the material over twice (so that the edge is hidden) and then stitch the hem.

The presser-feet and attachments that I am considering, low shank feet, are interchangeable *between* machines, even of different brands and different manufacturing dates. And so some manufacturers standardised the most important features of their machines.

Most of the photographs in this article were made using two different Singer 201K machines, made in 1936 and 1948.[1] The 201K manufactured in 1936, pictured below, is in use nearly every day, by a person who was also born in 1936.

What should be clear from the underneath view of the gears, is that every component is substantial and, provided a little oil is given, nothing will wear out. Indeed, this sewing machine could last another hundred years or more of use without it failing; unless, of course, it is dropped on a hard surface and the castings break. How many other machines will last for 83 years, let alone over a hundred years?

There are only three obvious parts that need to be interchangeable: the needle, the thread and the bobbin. In addition, the treadle belt and the rubber tyre on the bobbin winder need to be replaced occasionally.

*Nothing else needs to be interchangeable because nothing else needs to be replaced.*


1 Askaroff, 2019.

# Simple Presser-Feet

Older mechanical, lock-stitch domestic sewing machines can only stitch in a straight line. Figure 1 shows the basic mechanism of a "modern" Singer 201K made in 1948. A spring loaded *presser-foot bar* has the *presser-foot* attached to it, and the presser-foot holds the material firmly against the saw-tooth *feed-dogs* in the base of the machine. The feed-dogs (synchronised with the needle) have, in the photograph, a left, down, right and up motion, which draws the material past the needle, allowing a line of stitches to be produced.[2]

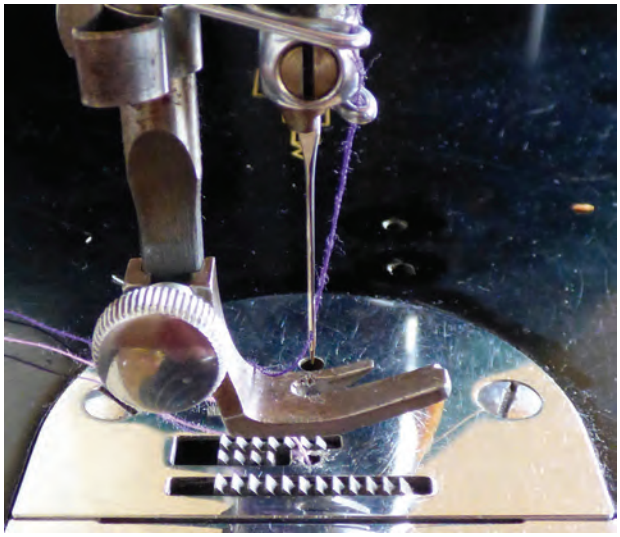


Figure 1

These feed-dogs were patented by Allan Wilson in 1854.[3]

Figure 2 shows the mechanism in the head of the same machine.

The left rod ***A*** is the spring-loaded presser-foot bar and controls the presser-foot; the lever ***B*** on the outside raises it, as in Figure 1.

The center rod ***C*** is the *needle bar* and has the needle attached to it and it can only move vertically, controlled by the linkage ***F*** that attaches it eccentrically to the drive shaft ***D*** running from the back of the machine. (A second linkage ***G*** is attached to a lever at the upper right to control the thread tension.) The counter-weight ***E*** is to avoid vibration.

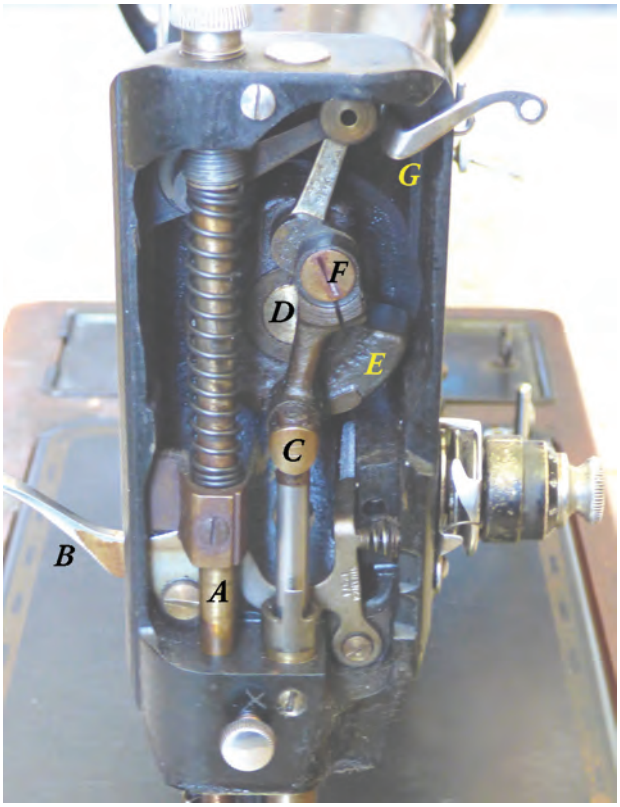



Figure 2

Clearly the needle cannot move sideways and the only variation possible is the stitch length, which is controlled by the distance the feed-dogs move.

There are several ways to form the *lock stitch*, when the thread in the needle is inter-twined with a second thread in the base of the machine, and these mechanisms are described in detail elsewhere.

In addition, most photographs of sewing machines do not display the presser-feet or how they are joined to the rod or square bar that holds them. And of the few useful photographs, the machines in them are not dated and the chronology of changes in the design of presser-feet and attachments is very hard to quantify.

Consequently, the history of presser-feet is largely unknown.

In Figure 1 the presser-foot is *side-clamped* and held on by a large thumb-screw, so it can be easily replaced by another presser-foot. But early machines did not have this feature and were limited to one or a few similar designs. For example, some photographs indicate that the presser-foot is fixed onto the presser-foot bar and cannot be removed. And other designs appear to have the presser-foot held by an ordinary countersunk screw or nut threaded onto the rod.

2 Wikipedia, 2019b.
3 Warren, 2020.

However, there is some documentation of Singer presser-feet and attachments. This is because from about 1888 Singer produced *attachment sets* with manuals, and many of these were held in folding boxes that are commonly called *puzzle boxes*.[4] The majority of these boxes were produced in the 19th century because a style 12 manual is dated 1895.[5]

Figure 3 is an attachment set in a folding box made in 1889;[6] it is now commonly called a style 1 set. And Figure 4 is a late style 11 set in a folding box dated about 1905; both are for vibrating shuttle machines. In Figure 3 the parts are held in place by small thumb-screws, but in Figure 4 they slip under metal clamps.

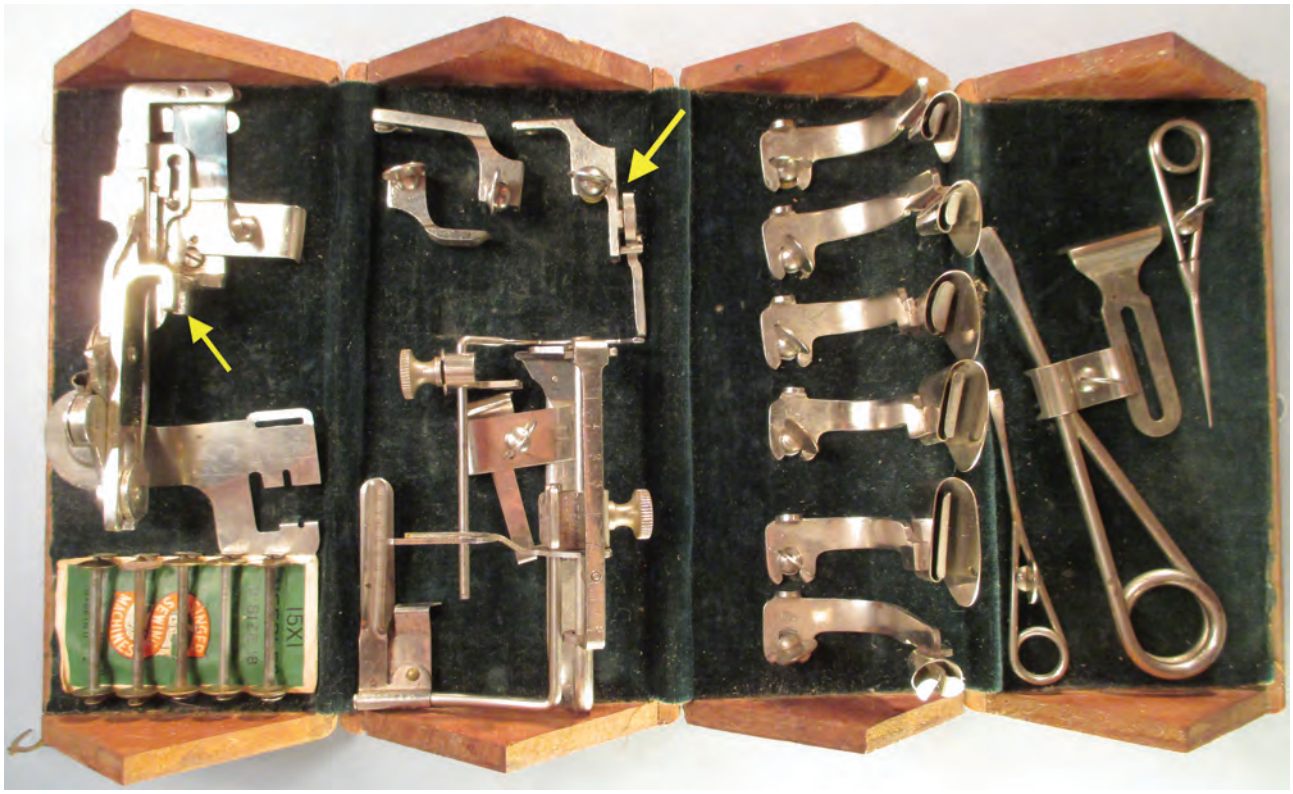


Figure 3

The important feature is the method of attaching the feet:

(a) Style 1, Figure 3: The left arrow in Figure 3 (pointing to the ruffler) clearly shows that the machine used side-clamping and, although difficult to see, the three feet, with the top arrow pointing to one, are also side-clamping. However, in the second compartment from the right, the five *wide-hemmers* and the *binder* have long, curved posts and are clamped from the back!

This is why there is a complex *attachment foot* 7 highlighted by the top arrow. The attachment foot is side-clamped onto the presser-foot bar, and the attachment has a slot that fits between the lever and the base of the foot. Then the lever is raised up to lock it into place, as in Figure 6.[7]

(b) Style 11, Figure 4: This also uses side-clamping, but again the five wide-hemmers and the binder do not attach directly. Instead these accessories terminate in a rod that is inserted into the attachment foot and fixed with a thumb-screw.

However, the contents of the different style sets is not clear, as many photographs of them appear to have an assortment of parts that actually belong to different styles and the boxes are often missing parts. For example, a Wikipedia photograph of a "style 14 box" has parts from several styles in a late style 11 box.[8] And Figure 4 has an obviously incorrect screwdriver and an added hemmer foot.

4 Needlebar, 2020a; Wikipedia, 2020b.
5 Stuart, John, 2020.
6 Singer, 1889a; Griest, 1889.
7 Phillips, 2008.
8 Wikipedia, 2020b.

Figure 4

Singer also produced attachment sets in tins, cardboard boxes and plastic boxes; Figure 5 is a circa 1955 attachment set for a Singer 222K sewing machine.

Most of these presser-feet are simple in that their purpose is to make it easier to manipulate the material while sewing in a *straight line*, the only thing that these sewing machines can do. (It is possible to sew in a curve by turning the material after each stitch.)

Figure 5

For example, Figure 6 shows the use of a style 1 wide-hemmer attachment and the way it is mounted on an 1888 vibrating shuttle machine:

> *Substitute the attachment foot for the ordinary presser-foot, and attach the wide-hemmer to it as shown above. … Enter the right-hand edge of the cloth into the hemmer, turning it to the left until it fills the scroll. Lower the presser-foot and commence to sew, being careful to hold the goods so as to keep the scroll full.* [9]

The hemmer is very important because it is used to stop the edge of the material fraying. Similarly the binder foot attaches a separate, narrow piece of material to the edge of the main material. And many other presser-feet achieve other common tasks which are difficult to do free-hand.

Figure 7 shows the same type of hemmer, but with a later method of attachment to another vibrating shuttle machine.[10]

This form of attachment was included in a set in a cardboard box, and it appears to be earlier than the style 3 set (page 28). The binder and the set of wide-hemmers are attached by the braiding foot, Singer Part No. 25510.[11]

In addition, Figure 8 shows the attachment method used in the style 11 set; it is the same as in style 3.

There is no doubt that the presser-foot bar and its side-clamping flat and screw hole were standardised at some time before 1888.

But also the distance between the presser-foot bar and the needle rod must have been standardised, so that the needle can go down through the foot and into its hole in the bed of the machine.

The style 3 set was made in 1892 and the style 11 set was made in the early years of the 20th century. However, most of the attachments fit onto the 1948 Singer 201K, and Figure 8 shows the style 3 set attachment foot and a wide-hemmer fixed to a Singer 222K manufactured in February 1957. That style also fits a Singer Model 27, circa 1900.

And, although perhaps unnecessary, these presser-feet and attachments also fit a Janome Memory Craft 7700 computerised sewing machine that was made about 2010.

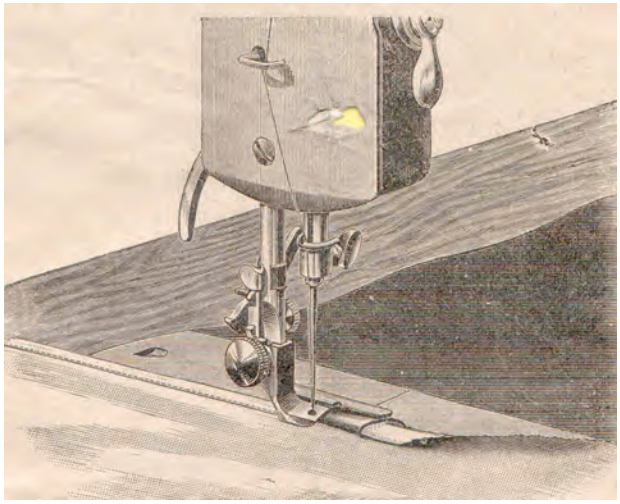


Figure 6

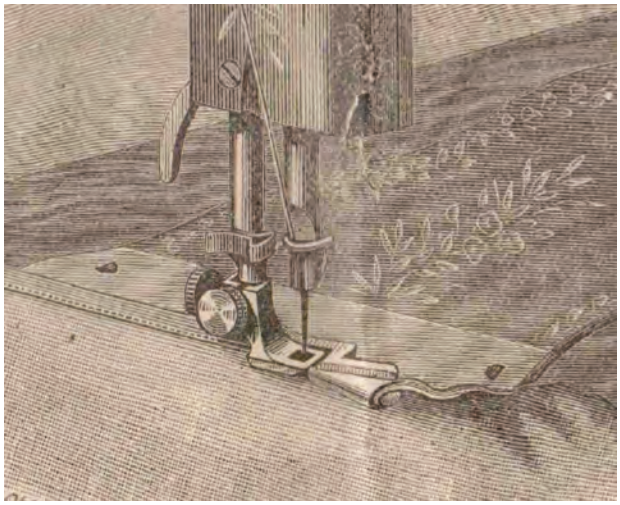


Figure 7

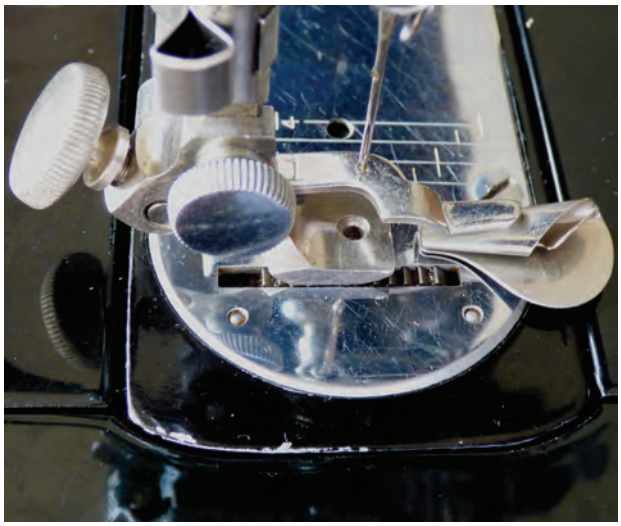


Figure 8

9 Singer, 1889a, page 15.
10 Singer, 1891b, page 19.
11 Singer Sewing Info, 2020b.

When Singer standardised their design is not known, but it was probably some years before the style sets were produced. Certainly the style 1 set was made to hold an existing collection of attachments, as the folding box itself was patented in 1889,[12] but the attachments in it are dated 1888.

So it is likely that Singer standardised at least the critical dimensions in 1885 when the Vibrating Shuttle No. 1 machine was produced.[13] (It is interesting that Singer's 1891 publication actually describes two different machines with different bed shapes.[14])

In addition, there are two photographs of different Singer Model 12 machines that are dated 1871, and they show that it has side-clamping presser-feet with a square presser-foot bar as in Figure 9. Although not certain, later presser-feet would probably fit it, pushing back the date of standardisation of the method of attachment, and the presser-foot bar and needle rod distance, by 14 years.

Figure 9 (Wolfegang's Collectibles)

This standardisation is very important, because the owner can use presser-feet and attachments on one machine even though they were originally made for a different machine.

An example of the importance of this is the Singer model 66 that was manufactured from 1902 to 1956.[15] Early model 66 machines used back-clamping presser-feet and attachments, as in Figure 10, rather than the common side clamping used on other models.[16] It is clear that this was a significant blunder, because it was quickly changed to side-clamping on later model 66 machines!

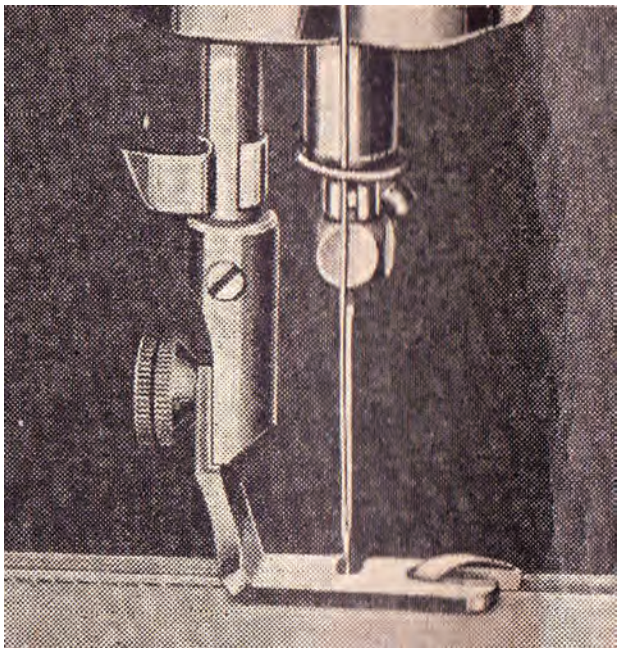


Figure 10

Another, quite early attempt to make interchangeable presser-feet was the 1876 Wheeler & Wilson sewing machine.[17] It had a fixed presser-foot into which inserts could be placed, Figure 11, but these were conveniences to help the user make ordinary straight stitches, and the only "clever" insert was the hemmer, again illustrating the importance of that design.


Figure 11

12 Griest, 1889.
13 Wikipedia, 2020a.
14 Singer, 1891b, pages 2-3 and page 13, for example.
15 Singer Sewing Info, 2020c.
16 Singer, 1913a.
17 Wheeler & Wilson, 1876.

# Using the Motion of the Needle: The Walking-foot and Levers

A third feature of these sewing machines that appears to have been standardised in the 19th century is the method of attaching the needle.

Figure 12 (of a Singer Model 201K) shows a horizontal boss into which there is the thumb-screw holding the needle in place.

A similar design is used in the circa 1900 Singer Model 27 and from Figure 6 we can see that the a similar design was used in 1888.

The Singer Model 12 in Figure 9 is different, having a large, cylindrical screw holding the needle, similar to the screw holding the presser-foot. The ruffler in Figure 40 (page 20) would probably fit it, but the later zig-zag and buttonhole attachments may not.

Figure 12

However, the important feature of all these machines is that *the needle rod has a useful point of attachment* and this can be used by attachments mounted on the presser-foot bar.

Although used in several situations, the primary purpose of a *walking-foot*, also called the *even feed foot*, is when sewing two layers of material together. In that situation, especially if the top layer is smooth, the feed dogs in the base of the machine might move the bottom layer but the top layer may be stationary or move a different distance.

The walking-foot overcomes this problem by using the motion of the needle, as well as the feed dogs in the base of the machine, to move both layers of material along with it.

Figure 13 shows a "cheap and nasty" walking-foot that falls apart when the clip-on cover and a single screw is removed, and consequently it is very hard to reassemble it without some sort of third hand.

It has its own feed-dogs ***3*** that are attached to a metal strip ***10***. The strip is screwed to a block ***11*** that runs in a slot in the body ***12***, so that the feed-dogs are loose and can move backwards and forwards. And there is a small spring under the holding screw so that the feed-dogs are continually being pressed up away from the material.

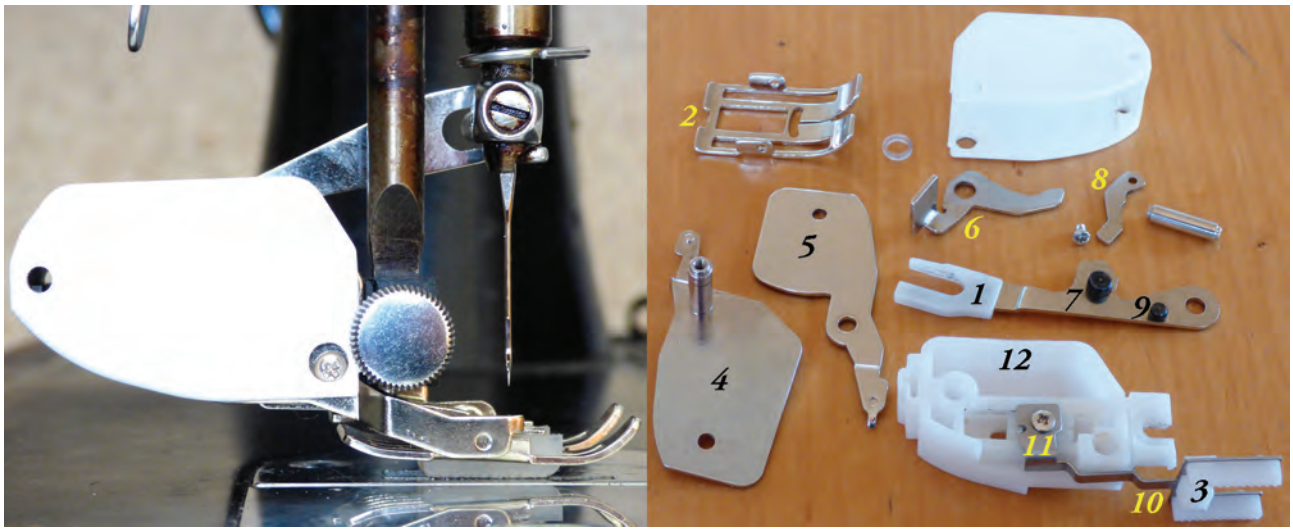



Figure 13

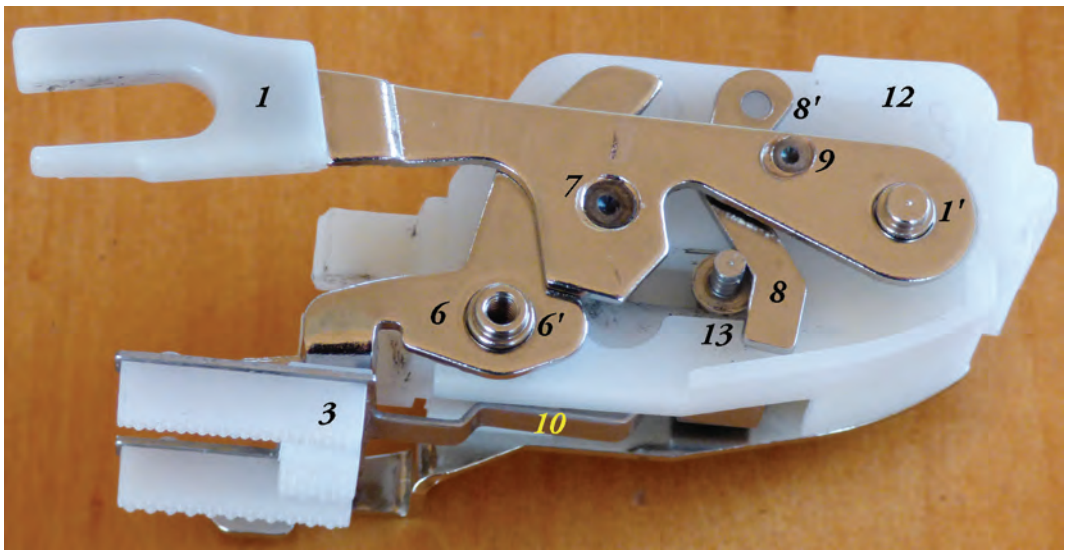



Figure 14

The foot ***2*** is mounted between the cover plates ***4*** and ***5***. In this context (and later) the *foot* is the part of the attachment that normally presses on the material.

There are three levers to control the motion of the feed-dogs ***3***, Figure 14. The needle arm ***1***, that is fitted around the needle attachment point, is a lever pivoted at ***1′***. It has two fingers *7* and ***9*** to control the positions of the levers ***6***, pivoted at ***6′***, and ***8***, pivoted at ***8′***.

When the needle arm rises, the finger *7* forces the lever ***6*** to rotate anti-clockwise and the pad at the end of that lever tries to force the feed-dogs ***3*** down to below the surface of the foot ***2***.

However, when the lever ***6*** rotates, the feed-dogs cannot drop, because they are stopped by the machine's feed-dogs and the material, and it actually causes the whole body ***12*** and the foot ***2*** to *rise up*, as in Figure 13 left. This is possible because the foot is only held down by the spring at ***A***, Figure 2 (page 3).

At this point the material is clamped only by the two sets of feed-dogs. As the machine's feed-dogs are up and moving the material, the feed-dogs ***3*** can move in unison, because the lever ***8*** is loose and the metal strip ***10*** is free to move in its slot in the body.

When the needle arm drops, the lever ***6*** is loose and the feed-dogs are free so that the body ***12*** drops down again and the foot ***2*** holds the material in position. At the same time the machine's feed-dogs have dropped.

Also when the needle arm drops, the finger ***9*** moves the lever ***8*** clockwise. The pin ***13*** is at the end of a rod to which the feed-dogs are screwed via the metal strip ***10*** and the screw at ***11***. So the lever ***8*** forces the pin ***13*** and the feed-dogs to the left, which moves the feed-dogs out to the front of the foot ***2***.

This is possible because the feed-dogs are only held by the spring under the screw at ***11***, which lifts the feed-dogs up so that there is no or only light contact with the material under them. When the needle arm rises, the lever ***8***, and hence the feed-dogs, are free to move backwards.

So when the needle arm is up and the machine's feed-dogs are active, the top piece of material is firmly pressed against the bottom piece by the feed-dogs ***3*** and both sets of feed-dogs can move the material without the friction of the foot ***2*** holding it back.

And when the needle drops the foot holds the material in place while both sets of feed-dogs move forward, but out of contact with the material, ready for the next stitch.

Figures 15a and 15b show a Singer "Penguin" walking-foot with its black cover removed.[18] It has a similar action to the walking-foot in Figure 13.

18 Singer, 1953.

The foot ***2***, Figure 15a, can only move vertically because of the screws ***5***, and it is normally held up by the spring ***4***. When forming a stitch the foot is forced down by the needle arm ***1*** (which is under the needle clamp). At this point, as in Figure 13, the whole attachment rises up because the material is clamped between the foot and the machine's base.

When the needle rises the attachment drops and the foot ***2*** is lifted up by its spring so that it is above the material. Note that in this position the base of the foot is higher that the base of the "feed-dogs" ***3***.

The "feed-dogs" ***3***, Figure 15b, are also controlled by a spring ***6***, but they are pivoted above the spring at *7* and can only rotate.

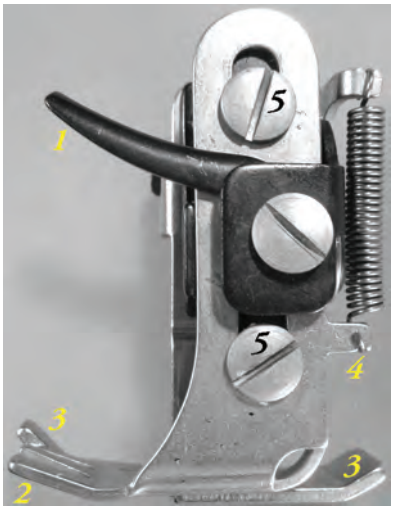


Figure 15a (Ericka Officer)

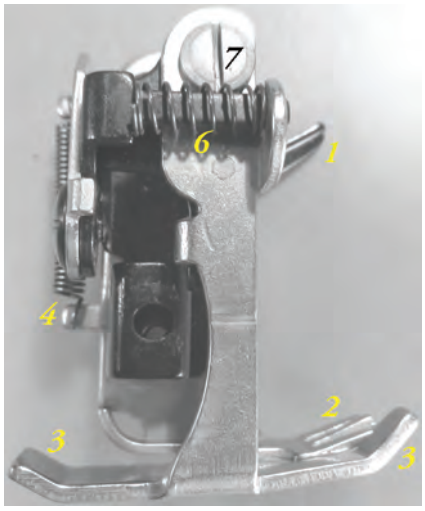


Figure 15b (Ericka Officer)

When the needle and the foot ***2*** rise, the "feed-dogs" ***3*** press down on the material and are free to move, clockwise in Figure 15b, in unison with the machine's feed-dogs, thus moving the upper layer of material.

When the needle drops and the attachment is lifted up, the "feed-dogs" ***3*** are not in contact with the material (or only very light contact) and the spring ***6*** rotates them anti-clockwise around *7*, returning them to the position in Figure 15b.

There are two important differences between this and the previous walking-foot. First, there are actually no feed-dog teeth under ***3*** in the Penguin walking-foot and it has a smooth surface that relies on friction to move the top material. Second, the foot ***2*** is used to lift up the attachment instead of the feed-dogs in Figure 13 left.

## Using the Motion of the Needle: The Tuck Marker

Another attachment that uses the motion of the needle is the tuck marker. There are many different designs, and some of these designs were included in the Singer style boxes. Although appearing to be complicated, Figure 16, it is actually quite simple.

This attachment is simply a guide to ensure all the tucks are of the same width and with uniform spacing.

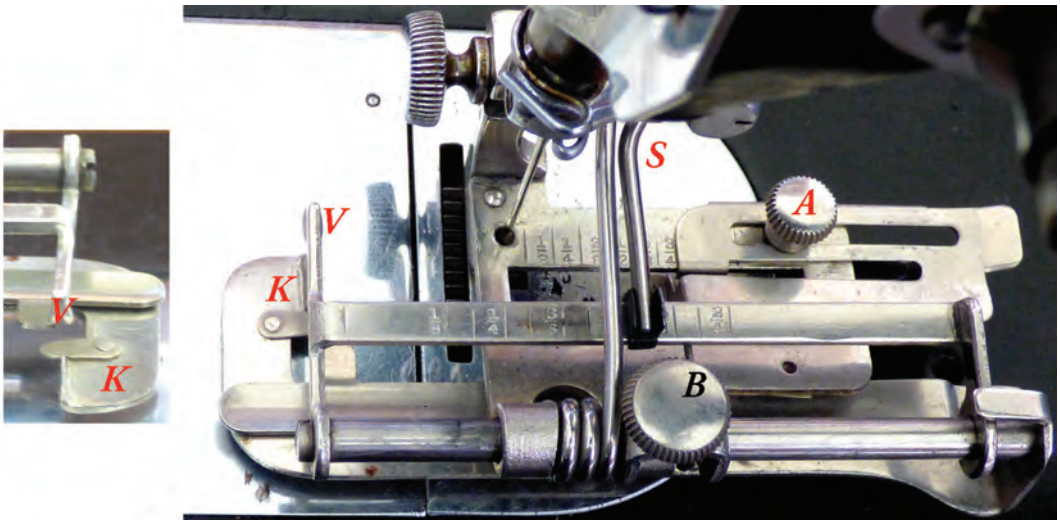


Figure 16

***A*** is the tuck scale, the width guide that the folded material is pressed against. ***B*** is the space scale that marks the position of the next tuck, consisting of a ***V*** slot and a knife edge ***K***, as in the inset photograph; the material is placed between them. The spring ***S***, which acts as a lever and goes under the needle clamp, presses ***V*** and ***K*** together, making a mark in the material at every stitch; ***K*** is not sharp enough to cut the material. Only the downward motion of the needle is used.

Figure 17 is a sample piece with three tucks and, at the top, the mark in the material for the next tuck.

Figure 17

There are a number of different designs for tuck markers, but they are simple and do not require further explanation here.

In tucks the material is stitched *down* the folds. In ruffles and pleats the material is stitched *across* the folds.

Although a discussion of ruffles and pleats, and the attachments used to form them, might be appropriate here it is deferred until later at page 18.

## Replacing the Feed-dogs: The Zig-Zag Attachment

Fundamental to the domestic sewing machines considered here is that the needle cannot move laterally, and its only motion is up and down to form a stitch.

Also, the motion of the material, and hence the stitch length, is controlled by the feed-dogs that move it in a straight line from front to back, as in Figures 1 and 12. And consequently, the machine can only sew in a straight line and, as the needle cannot move sideways, if we want to move the material in other directions then the feed-dogs have to be replaced by another mechanism.

As a result, a basic requirement of most *zig-zag* and *buttonhole* attachments are:

(a) A cover-plate that is screwed to the bed of the sewing machine covering the normal feed-dogs so that they cannot move the material; Figure 18. (Alternatively, many machines can drop their feed-dogs and so a cover plate is not needed.)

(b) Feed-dogs in the attachment to move the material, similar to a walking-foot.

(c) Cams or other mechanisms in the attachment that move its feed-dogs, and hence the material, sideways and backwards as well as the normal forward motion.

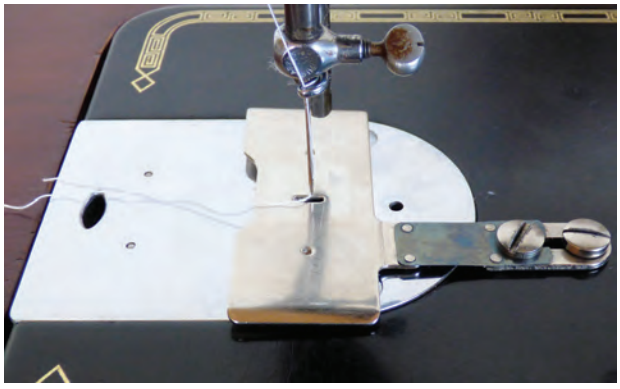


Figure 18

Figures 19 and 20 give four views of a Singer 160990 *zig-zag* attachment made in Switzerland; it uses the needle arm ***3*** to control its action.

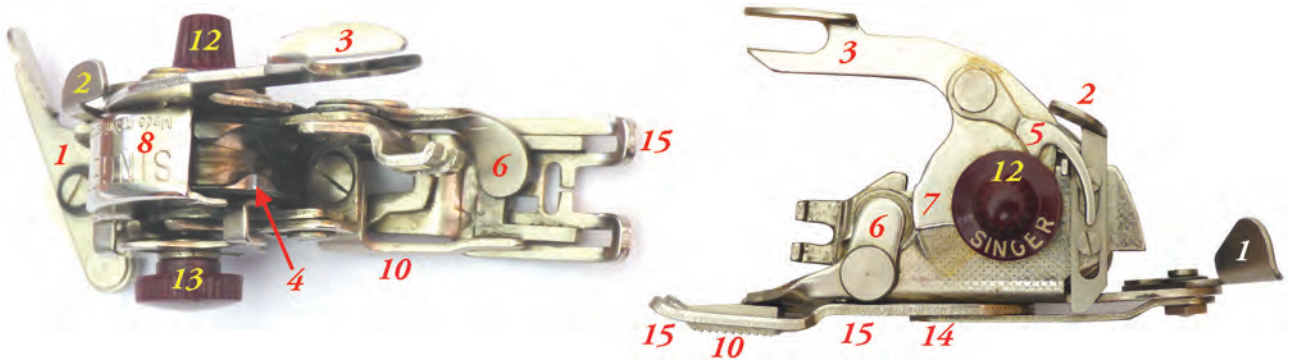



Figure 19

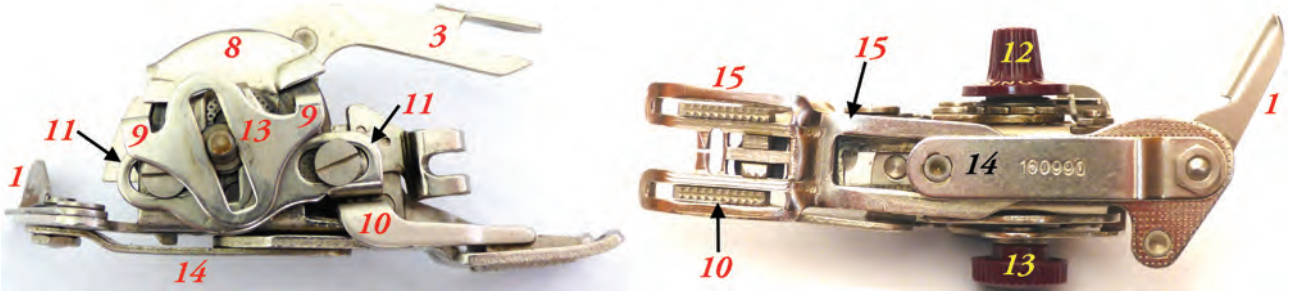



Figure 20

This attachment is a walking-foot with its own feed-dogs ***10***, and the cover-plate is needed to stop the sewing machine's feed-dogs being active if they cannot be dropped.

At every stitch, the pawl ***5***, Figure 19 right, is moved by the motion of the needle arm ***3*** and the pawl rotates a fixed, uniform ratchet, under the "SINGER" thumb-screw ***12***, which in turn rotates the main cam ***4***; there is a spring under the pawl's mounting disk to ensure it is always in contact with the ratchet.

This attachment normally produces a zig-zag, but the "throw-out" lever ***2*** can be used to raise and so disable the pawl ***5*** and the action of the cam, and then it will produce ordinary, straight-line stitches.

The foot ***15***, Figures 20 right and 21, is at the end of the integral lever ***15*** that reaches to the finger ***f*** that is under the main cam and hidden by the bar ***14***. The fulcrum of this lever is at ***14***, a boss on the bar that is linked to the adjustment lever ***1***, and moving the bar left or right moves the fulcrum ***14***, changing the amount that the foot moves sideways.

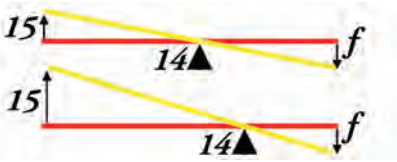



Figure 21

The feed-dogs ***10*** are pivoted at the end of their integral lever and, because they fit in gaps in the foot, they and the material also move sideways with the foot to form the zig-zag pattern.

The red thumb-screw ***13***, removed in Figure 20 left, adjusts the stitch length by changing the movement of the feed-dogs ***10***. The feed-dogs ***10*** are free to move up and down, but every time the needle arm rises the pad ***6***, Figure 19, forces the feed-dogs down allowing them to advance the material. This is done by the protuberance ***7*** acting on a roller wheel under ***6*** forcing the pad to rotate. As with the walking-foot discussed earlier, the feed-dogs ***10*** cannot move down, because they are pressed against the cover plate, and the pad ***6*** raises the whole attachment up so that the material is only held in place by the feed-dogs and the foot ***15*** is above the material.

The cover ***8***, Figure 19 left, that is over the main cam ***4***, is not decorative. It is fixed to the needle arm ***3*** and rotates with the movement of the needle. On the left side, Figure 20 left, the cover ***8*** has two pads that cause the stitch length lever ***9*** to rock.

The stitch length lever ***9*** is a U shaped piece, Figure 22, with one arm inside the body ***16*** and that arm is pivoted at the bottom. The feed-dog lever ***11***, which has the feed-dogs and their integral lever ***10*** pivoted at the end of it, is sandwiched between the stitch length lever and the body and held onto the body by two screws that run in elongated holes in the lever allowing it to move sideways.

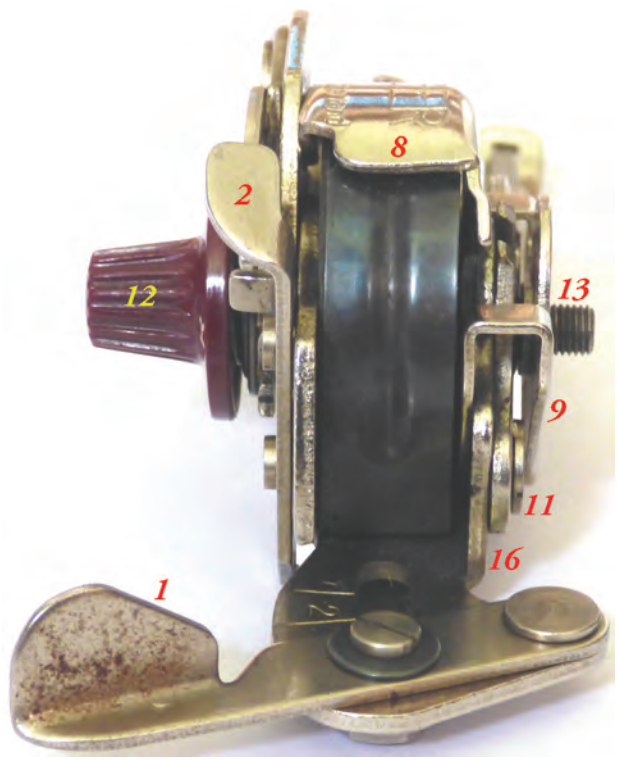


Figure 22

The screw under the thumb-screw ***13***, Figure 20 left, has a rectangular base that fits into the slot in the stitch length lever ***9***, and a circular extension that fits into a corresponding slot in the feed-dog lever ***11***.

Consequently, as the stitch length lever ***9*** rotates, it moves the feed-dog lever backwards and forwards to move the material. The thumb-screw ***13*** can be moved up and down the slot in the stitch length lever ***9*** to change the amount by which the feed-dog lever ***11*** and the feed-dogs ***10*** move.

The pattern cams, Figure 23, are ratchets that are put under the "SINGER" thumb-screw and are held friction-tight by a spring integral with the thumb-screw, but they are free to rotate. By interacting with the fixed ratchet they produce a variety of zig-zag patterns as shown in Figure 24; this figure uses paper piercing by the needle to show the pattern produced.

The fixed ratchet by itself produces a simple zig-zag, the pattern ***0***. The pattern cams, that are placed over the fixed ratchet, have some steps that are larger in diameter than the fixed ratchet. Consequently, when the pawl ***5*** meets a large step it rotates the pattern cam but it does not rotate the fixed ratchet, and so the main cam ***4*** does not rotate and a number of stitches are produced in a straight line.

Note that once the lever ***1*** has been set, the widths of all the patterns are the same and the only variation is when the sideways movement occurs.

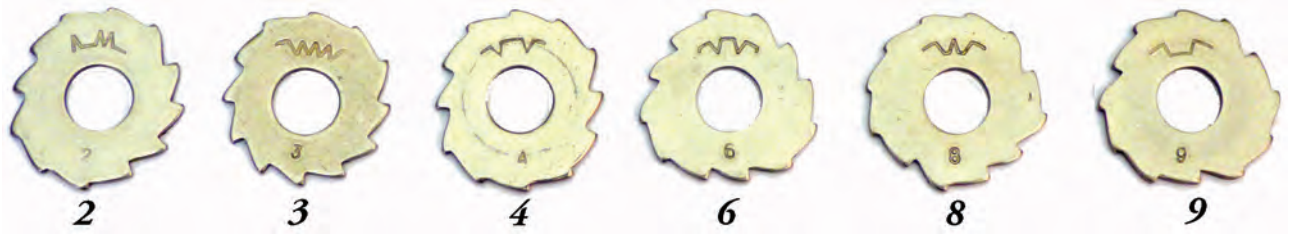


Figure 23

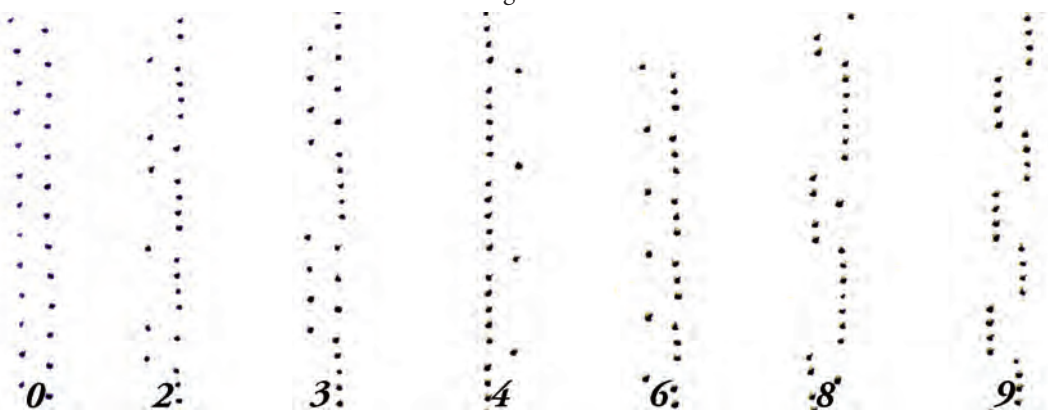


Figure 24

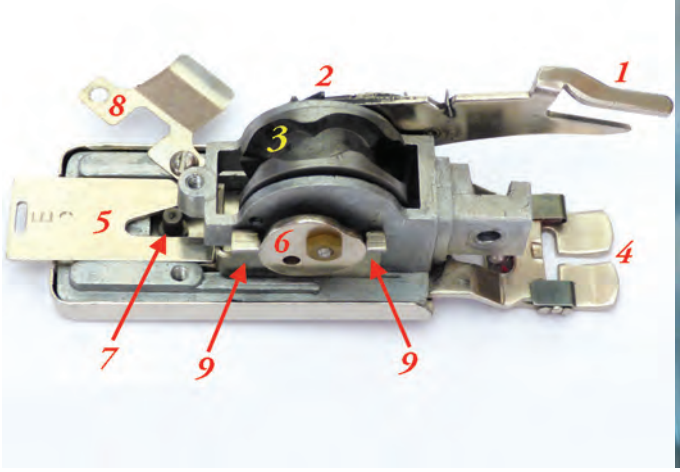



Figure 25a


Figure 25b

Figure 25a is a later YS-7 zig-zag attachment with its cover removed to show the main cam ***3***. It uses the needle arm ***1*** to rotate the uniform ratchet ***2*** and the main cam ***3*** to move its feed-dogs from side to side.

There are seven pattern plates for it, Figure 25b, that go into a carrier at the back of the attachment at ***5***; plate ***E*** is installed in Figure 25a, and the cover plate ***8*** has been moved to show the mechanism under it. These pattern plates change the pattern of the zig-zags; without a pattern plate it produces straight stitches. Note that, unlike the Singer zig-zag attachment above, with the pattern plates ***C*** and ***E*** the width of the zig-zag changes throughout. However, unlike the Singer, there is no way that the basic, maximum width can be changed.

These pattern plates fit into a carrier ***9*** that has two arms and it is moved forward and backward by a cam that is shaped like a heart ***6***; Figure 26.

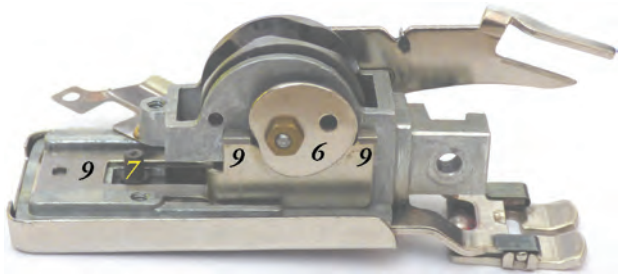



Figure 26

This zig-zag attachment is interesting because it does not use a plate to cover the normal feed-dogs and its feed-dogs ***4***, integrated in the foot, only have a sideways motion. Instead it uses the machine's feed-dogs and the machine's stitch length regulator for the forward motion. This is possible because the feed-dogs ***4*** in the zig-zag foot have teeth that are at right-angles to the machine's feed-dogs, going from front to back, as in Figure 27. Also the teeth face outwards, the left teeth facing left and the right teeth facing right.

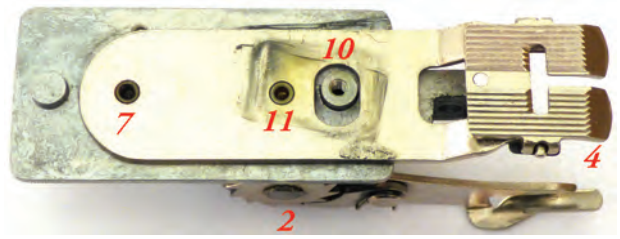



Figure 27

So when the foot moves sideways it takes the material with it, but the machine's feed-dogs can still move the material backwards at the same time.

The foot ***4*** is loose, free to move sideways but limited by a slot ***10*** in the base of the attachment, and so it is only held in position by the material and can rotate around its center ***11***, which is the finger acting on the main cam ***3***. This finger also acts in a slot in the base.

The needle arm ***1*** rotates the main cam ***3*** and the heart cam ***6***. By the finger ***11***, the main cam moves the foot sideways, but this movement is limited by the finger ***7*** that fits into the slot of the pattern plate. Because the foot is loose some of the sideways movement caused by the main cam then forces the front of the foot sideways to make a zig-zag. When there is no pattern plate the finger ***7*** is completely free to move and the foot oscillates around its center ***10*** without moving the material.

# Replacing the Feed-dogs: The Buttonhole Attachment

The buttonhole attachment is a more sophisticated zig-zag foot. This attachment is also a walking-foot with its own feed-dogs and, like the Singer zig-zag attachment, a cover-plate is needed to stop the sewing machine's feed-dogs being active on machines that cannot drop their feed-dogs.

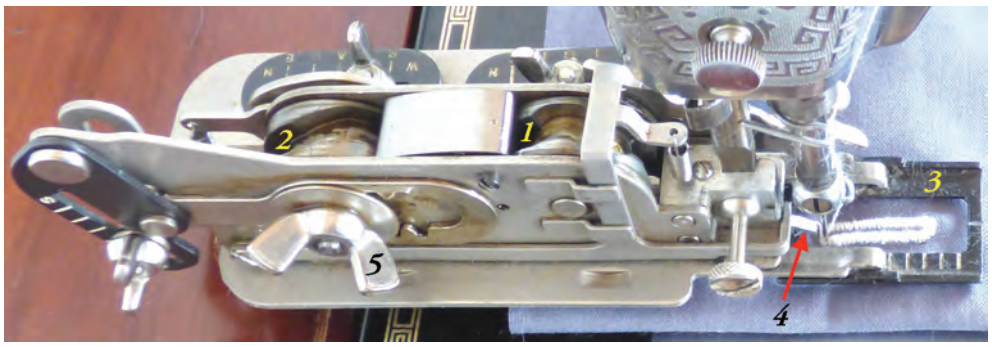



Figure 28

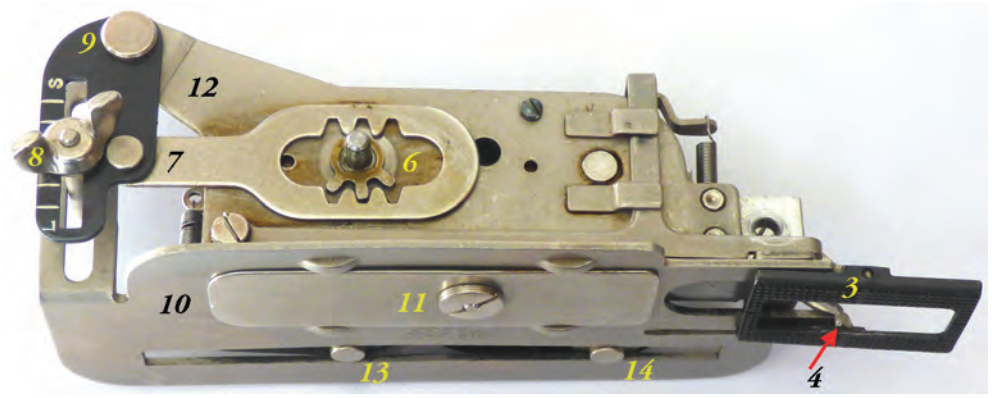



Figure 29

Figure 28 shows the left side of the attachment; it is complete except that its cover has been removed, and Figure 29 shows the left side of the attachment with the wing-nut ***5*** and the covering disk removed. The *zig-zag cam* ***1*** makes the small zig-zag stitches that form the buttonhole, and the *buttonhole cam* ***2*** moves the feed-dogs ***3*** to form the buttonhole. Because the gap in the feed-dogs is necessarily very large, an additional finger ***4*** is used to ensure the material does not move. The wing-nut ***5*** can be used to position the attachment before starting to sew.

Under the wing-nut there is a three-tooth wheel ***6*** that rotates with the buttonhole cam ***2***. It moves the double-sided rack ***7*** which is linked to the buttonhole length adjustment ***8***.

The base plate ***10*** is loose, Figure 30. It is held in position by the plate and screw ***11***, by the fingers ***13*** and ***14*** and by the rod at ***8***. The slots in the base plate allow it to move backward and forward, and the wide slot allows it to move sideways.

As shown in Figure 31, the pieces ***7***, ***8*** and ***9*** (Figure 29) form a lever pivoted to the body ***12*** at the fulcrum ***9***. The movement of the base plate ***10*** can be adjusted by the wing-nut and rod ***8***, and so the length of ***9-8*** can be varied from short ***s*** to long ***l***, as shown in Figure 29.

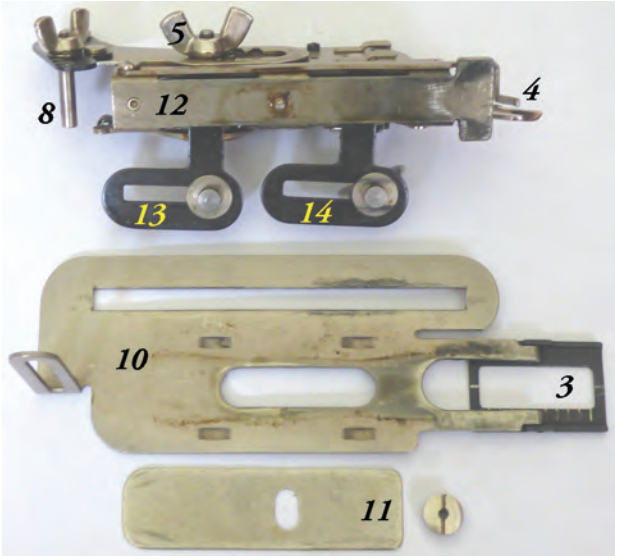



Figure 30

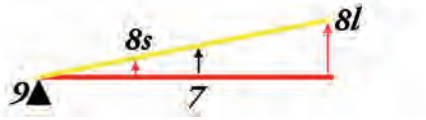



Figure 31

Consequently the motion of the rack ***7*** will move the base plate ***10*** different amounts depending on the position of the wing-nut ***8*** and so form different lengths of buttonhole.

At the end of stitching one side of the buttonhole, the finger under the buttonhole cam ***2*** moves sideways and moves the base plate to start the other side. During this process the three-tooth wheel ***6*** (Figure 29) fits into the end of the rack ***7*** and its teeth rotate while moving the base plate forward or backward a small amount until the teeth slot into the other side of the rack so that the zig-zag cam ***1*** can form the end of the buttonhole.

The pieces ***13*** and ***14***, Figure 32, are also levers, but the mechanism is hidden within the body of the Singer attachment and cannot be exposed because the components of the body are riveted together; but see Figure 35.

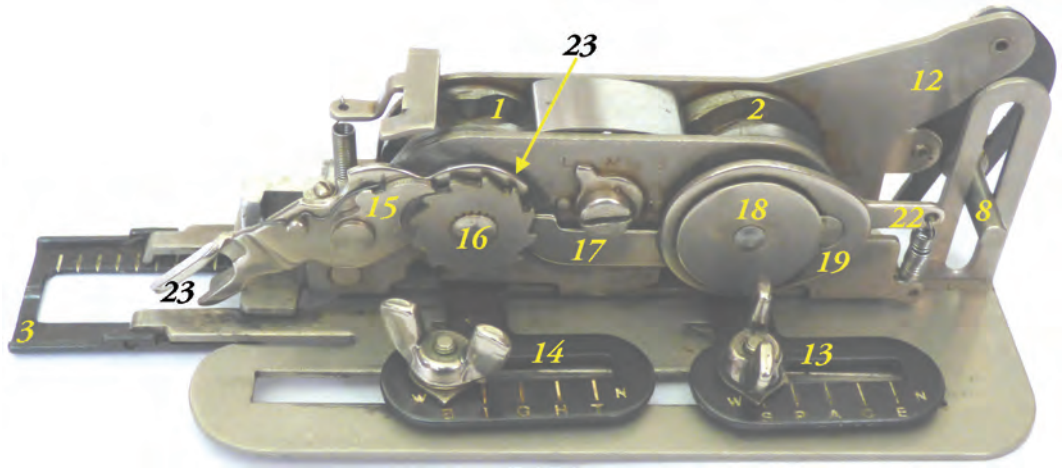



Figure 32

The lever ***13***, Figure 32, moves when the finger for the buttonhole cam ***2*** is pushed to one side or the other, and it moves the base plate sideways by varying amounts depending on the position of its wing-nut. This changes the space between the two rows of zig-zag stitches.

This happens twice for every rotation of the buttonhole cam and, as noted above, the base plate only moves forward or backward a small amount during this process.

The lever ***14*** is similar, but it responds to the position of the zig-zag cam ***1***. That cam is turned by the needle arm ***23*** via the spring-loaded pawl ***15*** that rotates the ratchet ***16***, as in zig-zag attachments. At every stitch the finger under the zig-zag cam moves the base plate sideways by an amount set by the wing-nut on ***14*** and this varies the width of the zig-zag stitches.

Thus the length, spacing and width of the zig-zag stitches that form the buttonhole can be adjusted.

Finally, how is the buttonhole cam ***2*** rotated?

The pawl ***15*** rotates the ratchet ***16*** and zig-zag cam ***1*** clockwise. The lever ***17***, and consequently the buttonhole cam ***2***, is rotated anti-clockwise by an extension of the needle arm ***23***. The cover plate on the Singer buttonholer, ***18*** in Figure 32, cannot be removed, and I assumed that the lever ***17*** was a pawl that rotated a ratchet. However, the mechanism is quite different and, although rather crude, it is effective.

Figures 33, 34 and 35 are of a YS-4455 industrial buttonhole attachment, made in China, that will not fit onto a domestic sewing machine. Although there are a few differences in layout, it is basically identical to the Singer buttonhole attachment and uses the same methods.

Three obvious differences are:

(a) The three-tooth wheel and the rack (***6*** and ***7***, Figure 29) are replaced by an oval cam and a bar linking the cam to the lever ***8***, ***9***, ***10***.

(b) The wing-nut (***5***, Figure 28) has been moved to the other side of the buttonholer.

(c) The two levers ***13*** and ***14*** are moved from the right side to the left side.

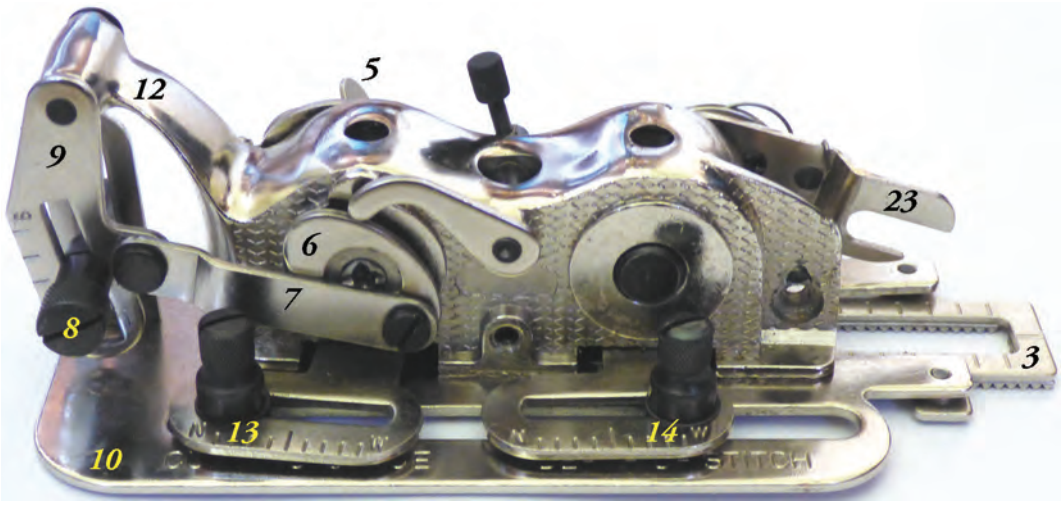



Figure 33

However on this attachment, Figure 34, the wing-nut ***5*** and the cover ***18*** can be removed. In both the Singer and YS attachments, the needle arm ***23*** rotates the lever ***17*** anti-clockwise on every stitch.

This lever is very loose and the hole in it is much larger that the pivot it surrounds! In addition, it has a boss ***19*** that is semi-circular but angled slightly so that only the top edge butts against the disk ***21***; that disk is fixed to the buttonhole cam ***2***.

The piece ***20*** fits tightly over the boss ***19*** and the disk ***21*** and, because of the boss, it prevents the lever ***17*** from moving sideways and it can only rotate.

When the lever ***17*** rotates anti-clockwise the boss has enough friction to rotate the disk ***21*** and the buttonhole cam. And when the needle arm ***23*** rotates anti-clockwise, freeing the lever ***17***, the spring ***22*** rotates the lever ***17*** clockwise and the boss ***19*** slides over the edge of the disk ***21*** without rotating it.

Finally, Figure 35 shows the two levers ***13*** and ***14*** that control the cutting space of the buttonhole and the width of the zig-zag stitches respectively, varying them from narrow ***N*** to wide ***W***.

The distance that the base plate moves depends upon the positions of the wing-nuts ***10***.

The distances of the fingers ***f*** from the fulcrums ***F*** are fixed, but the distances of the wing nuts varies from ***F-N*** up to ***F-W*** thus changing the distance the base plate moves.

Figure 36 shows the two positions of lever, folded as in Figure 35 and straightened out.

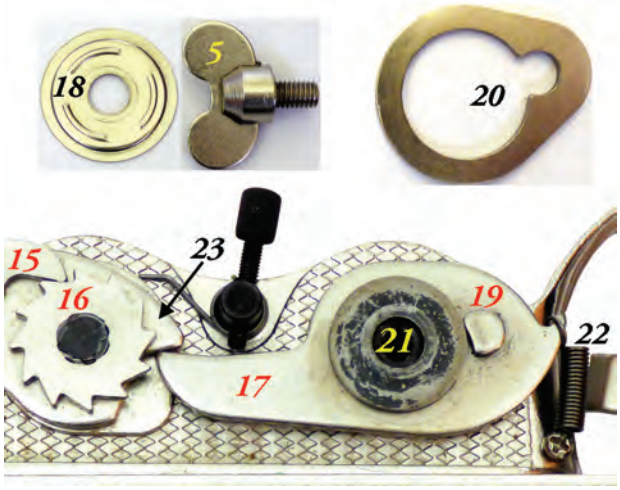



Figure 34

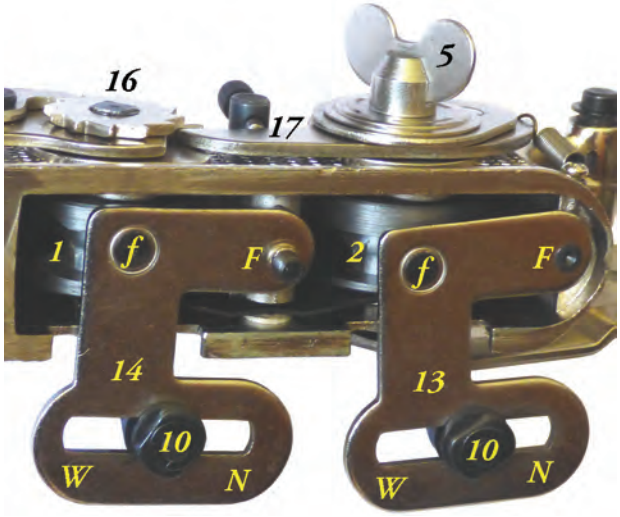



Figure 35

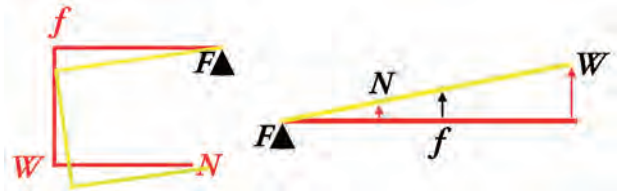



Figure 36

# The Art of Folding

Zig-zag sewing machines are old, but apparently the first domestic zig-zag machine was the Singer 206 made between 1936 and 1953.[19] It might be possible, but very difficult, to make a buttonhole by hand manipulation of the direction of stitching on it. Also, it might have been cheaper to buy zig-zag and buttonhole attachments for a straight stitch machine than to pay for a model 206, especially as these two tasks are relatively infrequent.

Modern sewing machines, like the Janome Memory Craft 7700 computerised sewing machine that was made about 2010, have in-built the ability to sew zig-zag stitches and to sew forward or backward under computer control. So the buttonhole attachment, Figure 37, is reduced to a simple guide that will make a buttonhole according to the machine's settings and the size of the button.

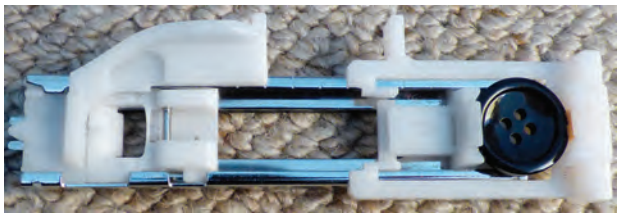


Figure 37

Consequently, the zig-zag and buttonhole attachments described previously are unnecessary.

*But none of these machines can fold material!*

The secret of the Singer attachment sets (illustrated on page 4, page 5 and page 27 on) is that they contain attachments to enable material to be folded easily and in different ways. They contain:

A narrow hemming presser-foot, as in Figure 10 (page 7).

5 wide-hemmers mounted on a special presser-foot (4 bed mounted wide-hemmers in the style 14 box).

A binder

A tuck-marker

A ruffler

That is, 9 attachments explicitly designed to fold material.

Other than screwdrivers and other accessories, the style sets only contain 2 attachments that do not fold material, the quilting guide and the under-braider.

In contrast, the Janome sewing machine has special presser-feet for:

A narrow hemming foot called a rolled-hem foot.

7 wide-hemmers.

A binder

A ruffler

That is, 10 attachments explicitly designed to fold material.

There is no tuck-marker and wide tucking is done by hand with a marker and an iron. There is a pintuck attachment for making very narrow tucks, but it is simply a guide to regularly space the pintucks. Also it uses two needles and so is not relevant.

Another similarity is that the Janome sewing machine has a separate walking (even feed) foot, as in Figure 13 (page 8).

19 Singer Sewing Info, 2020a.

Consequently:

*From before 1888 to now, the art of folding material has not changed.*

Of all these material-folding attachments, the only complex one is the ruffler and it is not surprising that its design has changed over the years. Unfortunately there are very few sewing machine manuals before 1889, when Singer started to produce instructions for its attachment sets, and even fewer are dated. So the early development of attachments, and the ruffler in particular, is largely unknown.

Indeed, about 1888 Bacle produced machines with a tuck marker, other guides and a "new pleating machine", Figure 38.[20] And another simplistic method of ruffling that does not use the movement of the needle was used by the Victor sewing machine.[21]

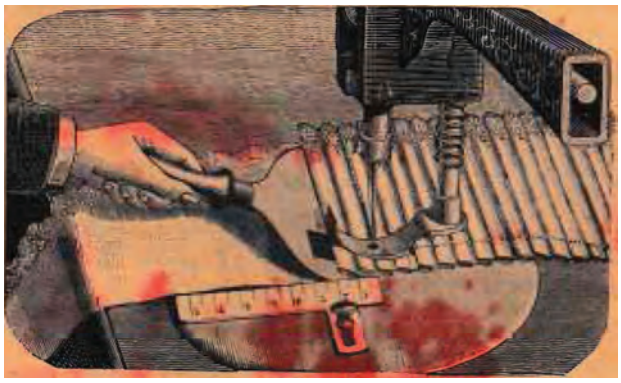


Figure 38

In addition, and most importantly, Alan Johnston of the Johnston Ruffler Company patented his ruffler in 1872,[22] and his design was used by a number of companies, including American Sewing Machine Company, Howe, New Home (1881), and Singer.[23] It is the earliest documented design that I know of.

The concept of a ruffler attachment is simple. In Figure 39 a lever ***C***, pivoted at ***1***, has the lever ***U*** attached to it by a pivot at ***2*** and ***U*** has the upper ruffler blade fixed to it; the two levers are used to change the direction of motion.

The body of the ruffler, that connects it to the presser-foot bar, is not shown. But the pivot ***1*** is part of the body and the lower ruffler blade ***L*** is attached to the body.

The separate needle arm ***A*** is also pivoted at ***1*** and has attached to it the two stops ***Sb*** and ***Sf***. In the diagram, ***Sb*** and ***Sf*** are at the ends of two levers ***l*** fixed to ***A***, but other arrangements are used.

As the needle arm rises, rotating it and the levers clockwise, the forward stop ***Sf*** pushes ***C*** and the upper ruffler blade ***U*** forward to the left to fold the material and form the ruffle.

As the needle arm drops, rotating anti-clockwise, the backward stop ***Sb*** pushes ***C*** and the ruffler blade ***U*** to the right, ready for the next ruffle.

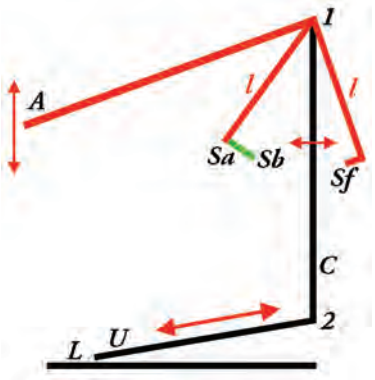



Figure 39

The distance of the forward stop ***Sf*** from ***C*** is fixed. This is necessary because it ensures that the material moves far enough to the right, but not too far, for the needle to catch the end of the fold when it forms the next stitch. The gap between ***Sf*** and ***C*** also ensures that the needle can rise out of the material before the upper blade ***U*** forms a ruffle.

The stop ***Sb*** can be adjusted by ***Sa*** (green). The size of the ruffle is determined by the position of the stop ***Sb*** relative to the lever ***C***, and how far the upper blade ***U*** moves to the right. If ***Sa*** is large and ***Sb*** is close to ***C*** most of the needle arm movement will be used to move the upper blade ***U***. And if ***Sa*** is small and ***Sb*** is further away from ***C*** more of the needle arm's movement is used to move ***Sb*** until it reaches ***C*** and consequently the upper blade ***U*** will move less. There are several forms of ***Sa*** by which the stop can be adjusted.

Because of the symmetry, one or both of the stops ***Sf*** and ***Sb*** can be attached to ***C*** to achieve the same effect.

20 Bacle, D, circa 1888.
21 Victor, circa 1880.
22 Johnston, 1873.
23 See Smithsonian Institution Libraries, 2001, and Smithsonian Institution Libraries, 2020.

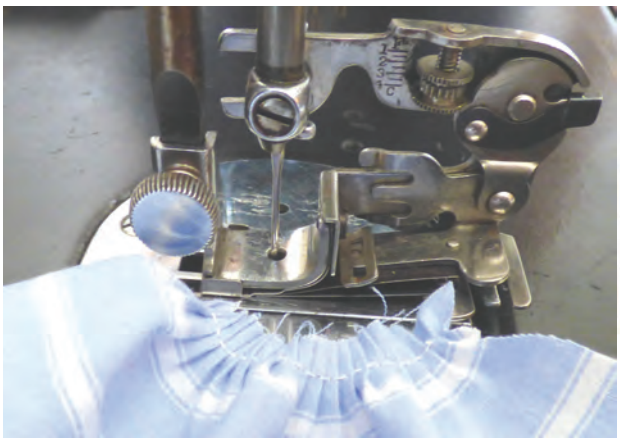


Figure 40a

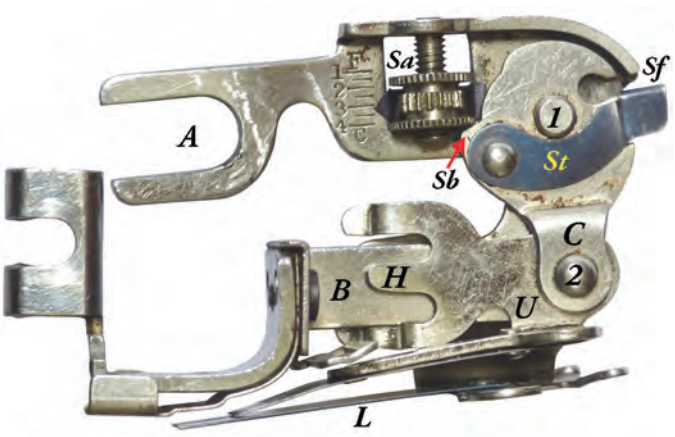



Figure 40b

Although out of date order, the Singer ruffler No. 26156 and what it produces, Figures 40a and 40b, is a good example of Figure 39.[24] The basic design was used from 1896 or earlier, and at least up until 1914.

The ruffler is attached to the presser-foot bar and the needle arm ***A***, pivoted at ***1***, is positioned around the needle clamp. The material is inserted between the two blued-steel blades at ***L;*** the upper blade attached to the arm ***U*** is shorter and has a serrated edge to grip the material.

When the needle rises after forming a stitch, the lever ***C***, also pivoted at ***1***, is rotated clockwise by the stop ***Sf*** and it moves the lever ***U***, pivoted at ***2***, forward and so moves the upper blade to the left; ***U*** can only move horizontally to the left because of its three-pronged fork ***H*** surrounding the body ***B*** of the ruffler. When the upper blade moves forward, to the left, it folds the material before the next stitch is made. Normally this movement clockwise cannot be varied because it is necessary that the upper blade moves the correct distance for the needle to go into the end of the fold.

However, when the needle arm ***A*** drops, the thumb-nut ***Sa***, mounted on ***A***, butts against ***Sb***, a ledge on ***C***, and rotates ***C*** anti-clockwise, moving the lever ***U*** and the upper blade back to the right. By changing the position of the thumb-nut, this motion can be varied to change the length of the ruffle.

It is no surprise that this ruffler will also fit onto a Janome Memory Craft 4000 computerised sewing machine circa 1997. And the reverse is also true; the Janome foot holder will fit on the Singer 201K and so Janome presser-feet attachments can be used with that machine.

The ruffler in Figure 40c is another version[25] and there are three differences in the design: the three-pronged fork ***H***, which is a part of ***U***, is replaced by a simpler wrap-around, a different style of thumb-nut, and the blued steel spacer, at ***St*** in Figure 40b, which is used for the different timings of vibrating shuttle and oscillating shuttle machines, is omitted.

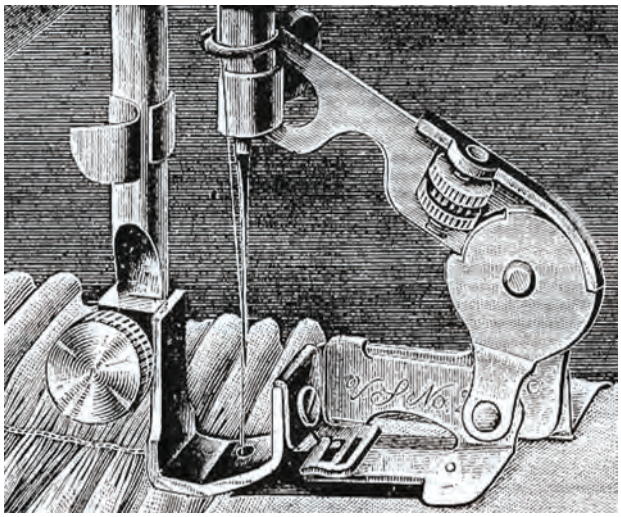


Figure 40c

There are at least 6 different designs of this ruffler: with or without the spacer, and varying ***H*** and the thumb-nut.[26] Also confusing is that 2 designs are given the same part number of 26156. (Unfortunately the 1896 book shows the same ruffler with and without the spacer.)

What is important is that this basic design had many variants, and so we must assume that other attachments had variants as well.

24 Singer, 1908, page 17.
25 Singer 1896, page 8.
26 For example: Figure 40b; Singer 1908; Singer 1914; Singer 1896, page 3; Greist 1897; and Singer 1896, pages 8-9.

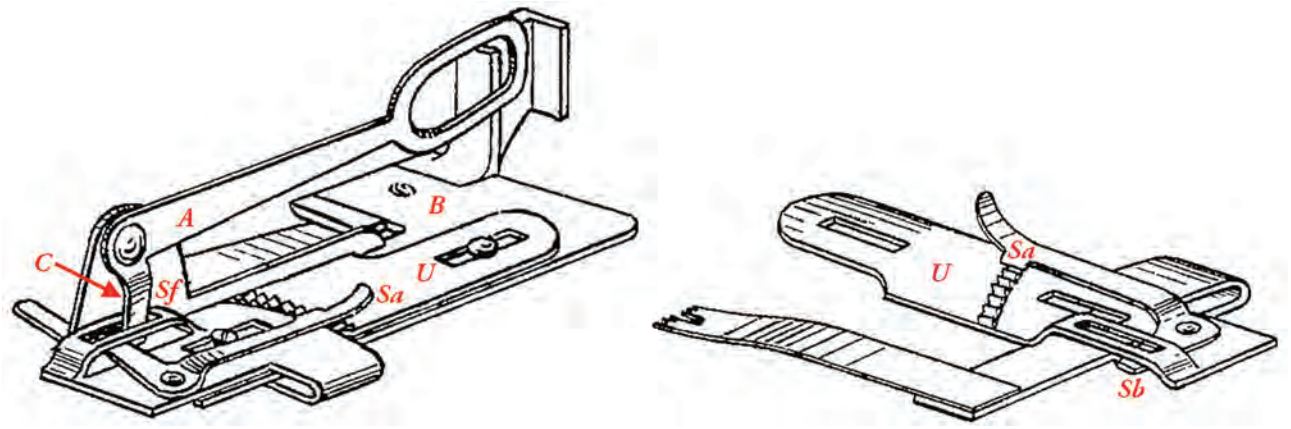



Figure 41a

As mentioned on page 19, the earliest documented ruffler is the Johnston ruffler in Figures 41a and 41b; the diagrams are from the patent.

The first point to note is that the needle arm ***A*** and the lever ***C*** are a single piece, and the consequence of this is that ***Sf*** and ***Sb*** are moved to ***U***, the carrier that holds the upper blade.

Figure 41b (John Stuart)

The lever ***C*** moves in a slot in ***U*** and ***Sf*** is the end of that slot, so when the needle rises ***C*** moves ***U*** and the attached upper blade forwards a constant distance. And when the needle drops, ***C*** meets ***Sb***, the end of the arm of ***Sa***, and moves ***U*** back by a varying amount depending on the position of ***Sa***.

The front of ***Sa*** is held by one of the teeth on ***U*** and if it is moved anti-clockwise (towards the needle) ***C*** will meet ***Sb*** later, the upper blade will be moved back a smaller distance and the folds will be smaller.

This design was modified over time; for example Figure 41b is different from the patent drawing.

The 1888 Singer ruffler, in the first attachment set,[27] Figure 42, appears to be different but it is basically the same design as Figure 39.

Because of the linear layout the lever ***C*** is split into two parts ***C-D***, hinged together at ***3,*** so that it can move ***U*** sideways. And the adjustment ***Sa*** is attached to ***C*** instead of ***A***.

When the needle arm ***A*** rises, the fixed stop ***Sf*** forces ***C*** down (clockwise in Figure 42 left) so that ***C-D*** is elongated and ***U*** moves the upper blade to the right to form a fold in the material.

When the needle arm drops, the pad ***Sb***, which is part of the needle arm ***A***, raises ***C*** anti-clockwise and ***D*** moves ***U*** to the left, ready for the next ruffle, by an amount that depends on the position of ***Sa***.

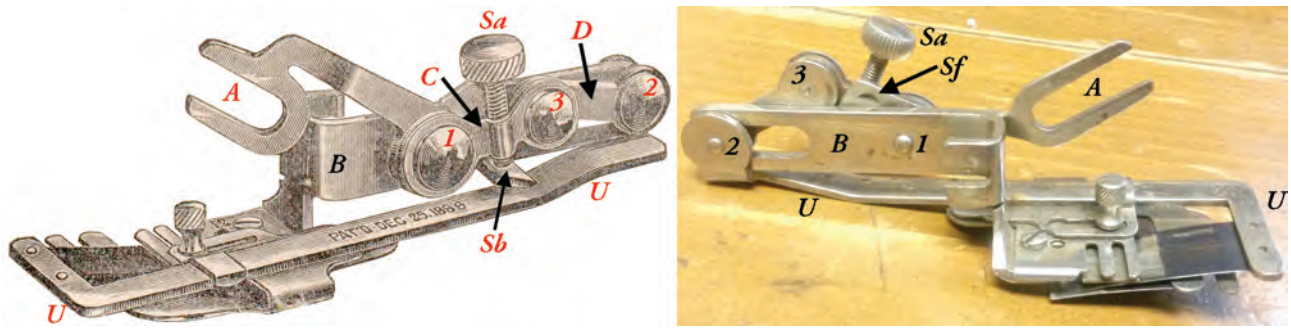



Figure 42

27 Singer, 1889a.

Contemporary with the previous ruffler is the back-clamped Wheeler & Wilson No. 9 ruffler, Figure 43.[28] It differs because it does not use the lever ***C***.

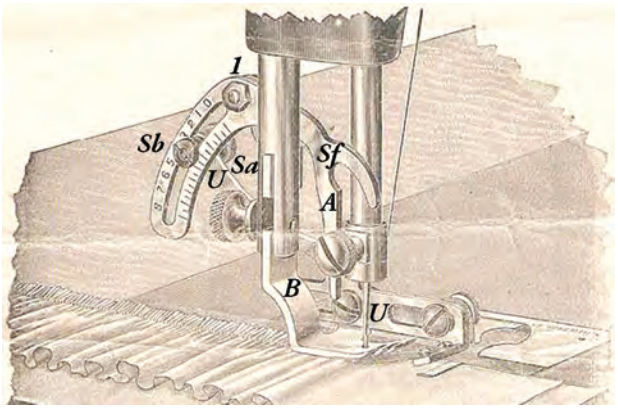


Figure 43

The needle arm ***A*** is pivoted at ***1*** and has ***Sb***, the scale for the adjustment thumb-screw ***Sa*** fixed to it. The hinged lever ***U-U***, extending from its pivot at ***Sb*** to in front of the needle, controls the motion of the upper ruffler blade. ***A-1-Sb*** forms a lever with its fulcrum at ***1***, and adjusting the length of ***1-Sb*** by the thumb-screw ***Sa*** changes the amount that the upper blade moves.

Most of the needle arm is vertical and the only part of it that interacts with the needle clamp is the very top, at the forward stop ***Sf***. At this point the needle arm is rotated by the needle clamp, anti-clockwise going up and clockwise going down.

When the needle rises, the arm ***A*** rotates anti-clockwise so that the needle clamp can fit into the stop ***Sf***. This motion moves ***Sb*** and ***U-U*** to the right, ready for the next ruffle. But this movement depends on the position of the stop ***Sb*** and so the motion of ***U-U*** varies. When the needle drops and moves away from the stop ***Sf***, ***A*** rotates clockwise, moving ***U-U*** to the left. The scale on ***Sb*** is an arc so that this movement is identical no matter where the stop ***Sb*** is placed.

A rather complex ruffler is that in Figure 44.[29]

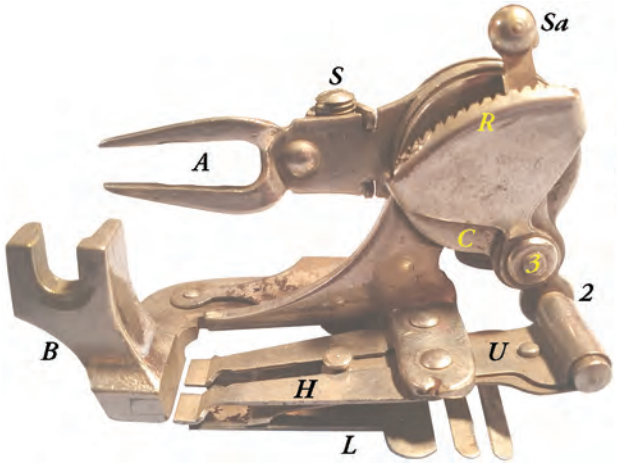


Figure 44a (Ericka Officer)

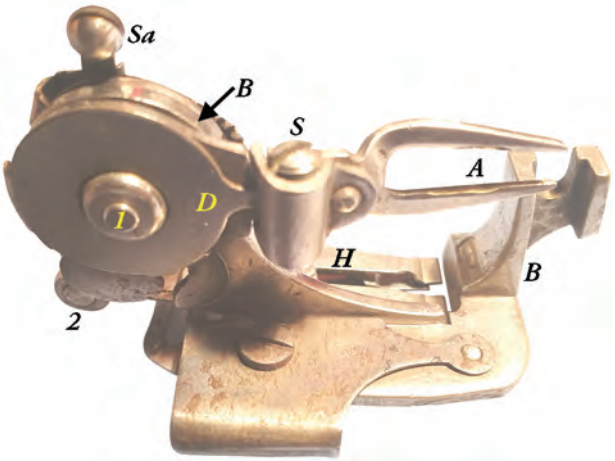


Figure 44b (Ericka Officer)

The lever ***C***, Figure 44a, is largely hidden by the ratchet ***R***, but it has a circular part around the common pivot point ***1*** and a linear part to the pivot ***2*** which attaches to the upper blade ***U***. Both ends of the ratchet ***R*** are folded over ***C*** so that they move together.

In Figure 44a, the adjustment ***Sa*** is a lever at the top of the ruffler and it can rotate about 70°. It is fixed to the pivot at ***3*** and held in a chosen position by the ratchet ***R***.

The pivot ***3*** goes from the lever ***Sa*** through to the other side of the ruffler and it has an oval cam fixed to it for the two stops ***Sf*** and ***Sb***, Figure 44c. So moving ***Sa*** rotates the cam. At ***Sf*** the oval cam is circular and the position of the lever in the ratchet does not affect it.

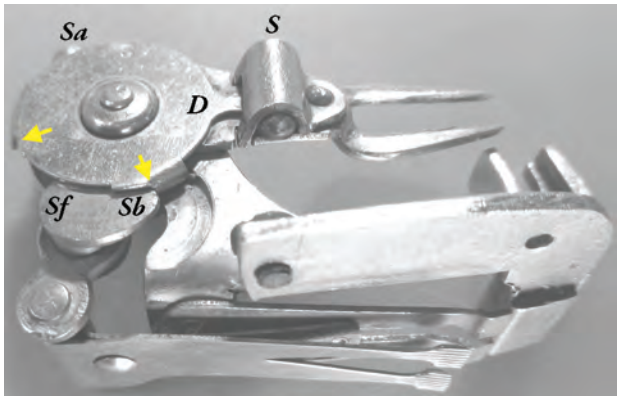


Figure 44c (Ericka Officer)

28 Wheeler & Wilson, ca 1888.
29 Singer, 1895a.

These stops are moved by the two pads on the disk ***D*** marked by the arrows, Figure 44c. The disk ***D*** is loose on the pivot ***1***, but held in place by a finger that goes to an adjusting screw ***S*** mounted on the needle arm ***A*** so that it rotates with the movement of the needle arm.

When the needle arm ***A*** rises, the left pad on ***D*** meets the oval cam at ***Sf*** and forces ***C*** and ***U*** to rotate anti-clockwise to move the upper blade forward the same distance irrespective of the position of the lever ***Sa***.

When the needle arm ***A*** drops, the right pad on ***D*** meets the oval cam at ***Sb*** and forces ***C*** and ***U*** to rotate clockwise to move the upper blade back. The distance that the upper blade moves back, and hence the size of the fold, depends on the position of the cam and what part of the oval face it meets.

The adjusting screw ***S***, Figure 44b, is fixed to the needle arm. It has threads top and bottom, but the middle part is cut out so that the finger on ***D*** fits into it. The adjusting screw is presumably used to ensure correct timing with the needle, like the blued steel spacer on the ruffler in Figure 40b (page 20).

Figure 45 is a much simpler way of using a ratchet ***R*** and a lever ***Sa*** mounted on ***C***.[30]

When the needle arm ***A*** rises, it butts against the end of the ratchet at ***Sf*** and moves the upper blade ***U*** forwards to the left. (The spring ***Su*** holds the upper blade ***U*** down in contact with the material.) This movement is always the same.

When the needle arm drops, ***Sb*** butts against the lever ***Sa*** and moves the upper blade back to the right. This movement varies, depending on the position of ***Sa.***

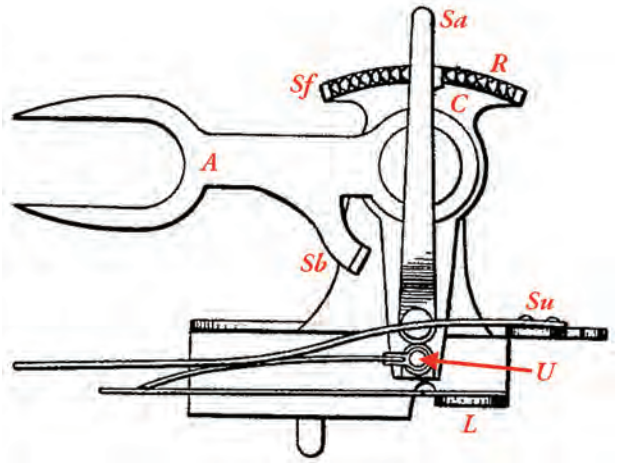


Figure 45

Although the illustration is poor, this design appears to have been used by the New Williams sewing machine.[31]

The Greist ruffler in Figure 46 is probably later.

The needle arm ***A***, pivoted at ***1,*** has the dial ***Sa*** attached to it, and the dial is the head of a screw that has the two levers ***l*** threaded onto it (they are shown in red in Figure 39, page 19), so that turning the dial moves the levers up and down, as in the inset photograph.

As the needle arm moves up and down, the levers ***l*** rock from side to side and move the lever ***C*** and hence ***U*** that is attached to the upper ruffler blade.

The distance that ***U*** moves depends on the vertical position of the levers.

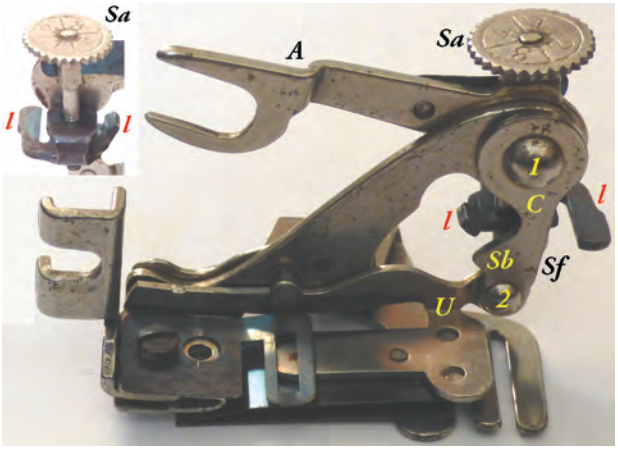


Figure 46

The stop ***Sf*** is the straight face of ***C*** and always moves ***U*** a fixed distance. However, the stop ***Sb*** is the other side of ***C*** that is shaped so that it will move ***U*** back by varying amounts depending on the position of the dial ***Sa***.

The numbers on the dial are meaningless decoration! Several turns of the screw are necessary to make any difference and the effect has to be determined by practice. But the numbers do have some meaning in that turning the dial in the direction of increasing numbers increases the size of the ruffle.

30 Johnston, A., 1886
31 Williams, nd.

Some sewing machine manuals that illustrate rufflers are available.[32] Of these the Florence Family Rotary, top-clamped, is the same as Figure 40c. The Howe (1867-1886) and the New Home (1881) are the same as Fig 41. The Domestic, Mason, Standard Paragon and Minnesota, all top-clamped, are variants of the Greist ruffler in Figure 46. In 1903 the Mason ruffler cost $1.00, about a day's toil for an unskilled worker.

The preceding rufflers have one thing in common; the folding of the material occurs at every stitch. The following rufflers allow for a number of stitches between the ruffles. They all rely on ratchets and pawls to modify the stitching.

Figures 47 and 48 are photographs of a Singer No. 120290 "1-star-5" ruffler. The needle arm ***A***, pivoted at ***1***, runs from the fork for the needle clamp to its finger ***F***. The 12-tooth ratchet ***R*** is loose, but is prevented from rotating clockwise (in Figure 47) by a spring. The bottoms of two diametrically opposite teeth on ***R*** are much deeper than the rest.

The pawl ***P***, mounted on the needle arm ***A*** above the fork, consists of a spring-loaded lever pivoted at ***Pp*** and going to the flattened, slotted section where the finger ***F*** can fit into one of the slots. A small part of ***P*** is bent down at ***Pr*** so that it can meet the forward stop ***Sf***, which is a cut-out part of the lever ***C***, and the ratchet ***R***. The pawl ***P*** can be moved to three different positions. At positions "1" and "5" it has slots for the finger ***F*** on ***A***. At the "star" position there is a slight depression under it to ensure the arm of the pawl cannot accidentally be moved.

In position "1" the pawl ***Pr*** has rotated sideways away from the ratchet teeth ***R*** and it drops under the pressure of its spring so that ***Pr*** will meet the fixed forward stop ***Sf***. When the needle arm rises, ***Pr*** meets the stop ***Sf*** and causes ***U*** and the upper ruffler blade to move and fold the material. When the needle moves down, the face of the adjustment screw ***Sa*** meets the back stop ***Sb***, which is an arm on ***C***, and returns ***U*** and the top ruffler blade back as far as is needed for the size of the folds. So the material is folded at every stitch and the ratchet does not rotate.

In position "5" the pawl has been rotated sideways so that ***Pr*** lifts up and meets the ratchet teeth ***R***. When the needle rises, the normally cut teeth of the ratchet hold the pawl up so that it is above the level of the forward stop ***Sf*** and consequently it does not move the lever ***C*** and no folding takes place. That is, the ratchet rotates anti-clockwise (in figure 47) by one tooth and a normal stitch is made.

However, after the ratchet ***R*** has rotated 5 teeth and 5 stitches have been made, the pawl meets a deeply cut tooth on the ratchet that allows ***Pr*** to drop so that it meets the forward stop ***Sf*** and a fold occurs; the behaviour then is exactly the same as for the position "1". Because in position "5" there are 5 ordinary stitches between each ruffle, the position should be numbered "6" for ruffling every 6th stitch.

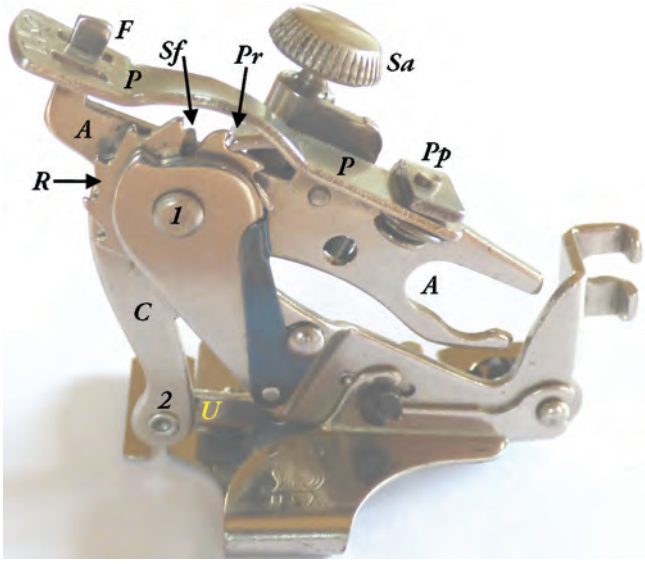



Figure 47

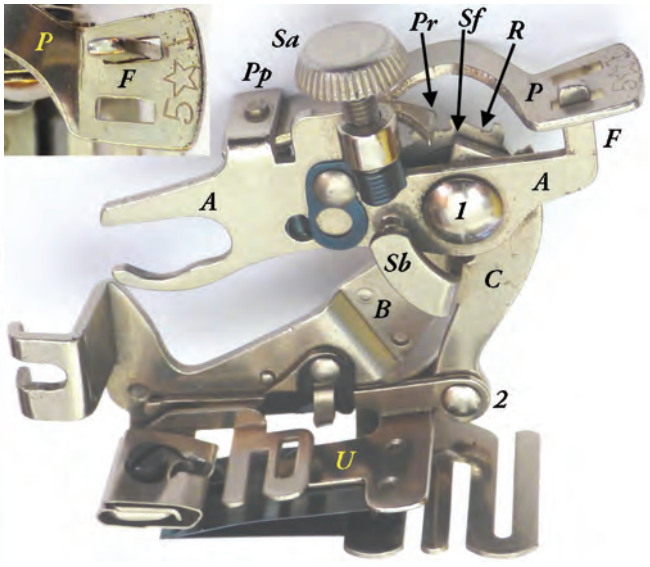



Figure 48

32 Victorian Sweatshop Forum, 2020a.

In position "star" the pawl is held above both the stop ***Sf*** and the ratchet ***R*** and the movement of the needle arm ***A*** has no effect, so no folds are made and the sewing machine behaves normally as a straight-stitch machine.

Figures 49 and 50 show a Simanco "1-6-12-star" ruffler.[33] The operation of it is basically the same as the "1-star-5" ruffler, except that it has two 12-tooth ratchets ***R*** that are fixed together. When the pawl is rotated to the "6" position ***Pr*** acts on only the inner ratchet which has the bottoms of two diametrically opposite teeth cut much deeper than the rest, and there are 5 ordinary stitches between each ruffle. However, in the "12" position the pawl ***Pr*** acts on both ratchets and the outer ratchet has only one deeper tooth corresponding to one of the deeper teeth on the inner ratchet. So only this tooth causes a fold and there are 11 ordinary stitches between each ruffle. It also has a timing spacer ***St***.

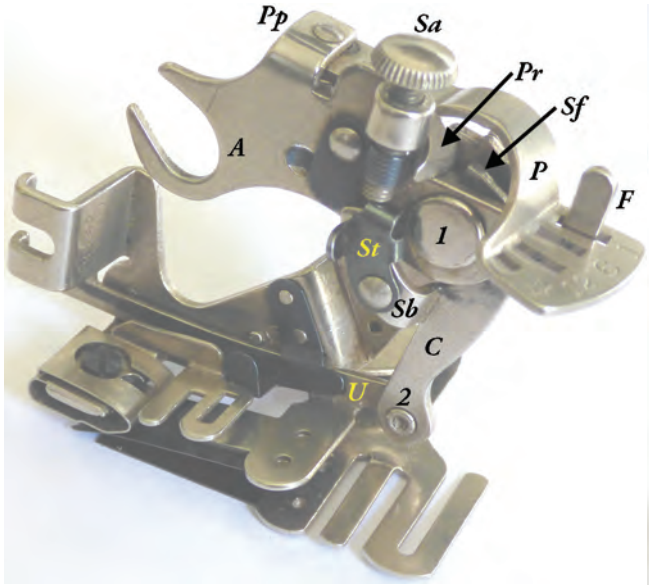



Figure 49

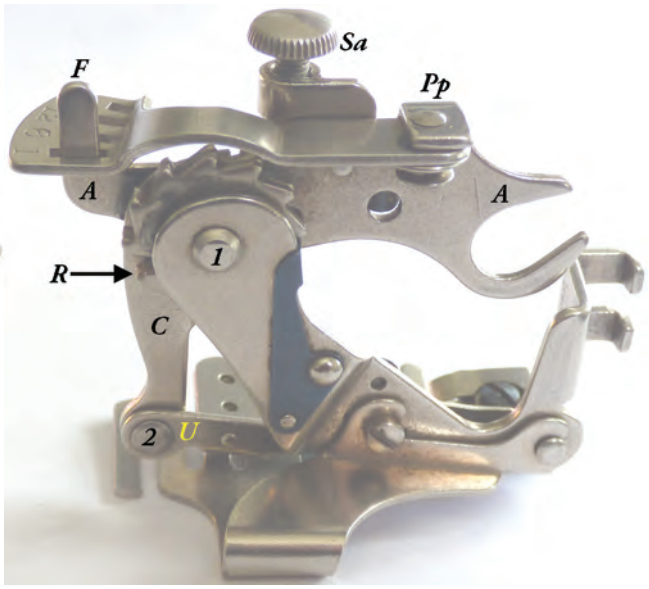



Figure 50

The ruffler attachment in Figures 51 and 52 is a little more sophisticated.

First, the outer ratchet in the Simanco ruffler above is replaced by a disk ***3*** that is shaped to block off one of the deep teeth when the pawl is rotated to position "12".

Second, the method of adjusting the back stop ***Sb*** is by changing the shape of ***C*** by rotating the cam ***4*** which is part of the adjustment ***Sa***. First, note that in Figures 47 to 50 the back stop ***Sb*** is part of the lever ***C*** and the adjusting screw is on the needle arm ***A***. However, in Figure 52 the positions have been reversed, with ***Sb*** now a part of the needle arm ***A***.

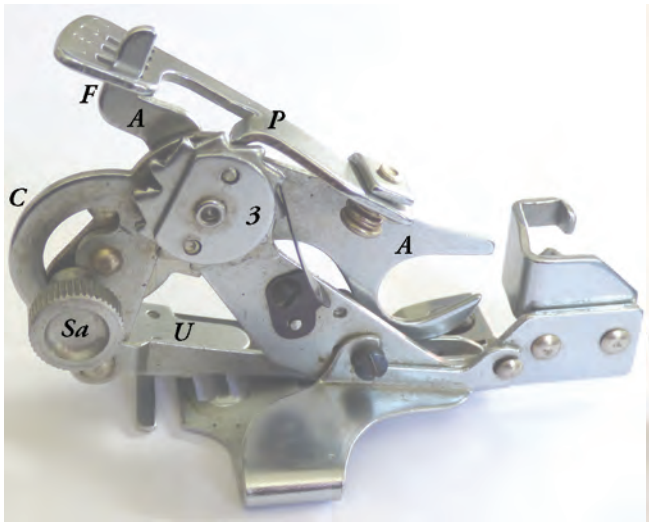



Figure 51

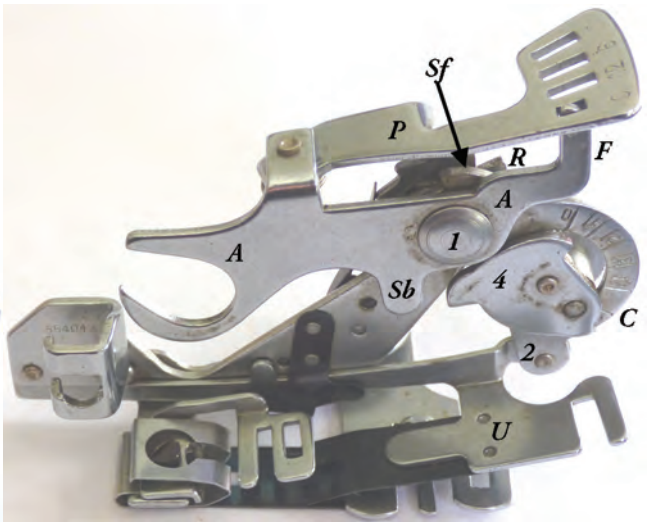



Figure 52

33 Singer, 1951.

There is a semi-circular scale that is part of the lever ***C*** and an adjusting thumb-screw ***Sa*** to lock the cam ***4*** in position. Rotating the cam ***4***, as in Figure 53, changes the gap between ***Sb*** and the acting face of ***Sa***, indicated by the arrow. Consequently the rotation of the lever ***C*** by the needle arm ***A*** when the needle drops changes.

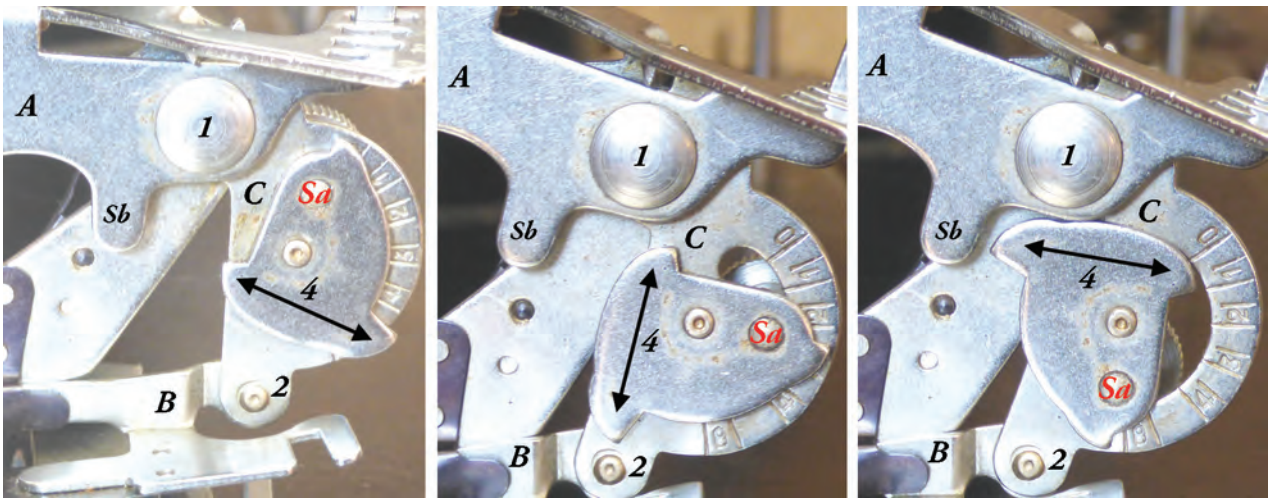



Figure 53

This appears to be the final design for a ruffler and, at the time of writing, it is used by the Singer and the Bernina "old style" rufflers. Bernina, Brother, Elna, Husqvarna, Janome, Pfaff and Singer produce rufflers with a disk or segment of a disk ***3*** replacing the second ratchet, but all these use a screw to adjust the left stop ***Sb***. Two, made by Husqvarna and Pfaff, have ***Sb*** being a part of the lever ***C*** and the adjustment screw ***Sa*** is on the top, as in Figure 45. The remaining rufflers have ***Sb*** being part of the arm ***A***, as in Figure 48, which moves the screw ***Sa*** to the front of the ruffler.

Finally, the Singer blind stitch attachment (part number 160616) is a zig-zag attachment that is used to create invisible hems;[34] Figures 54 and 55. It can be viewed as a simplified version of the YS-7 attachment (page 14) with the feed-dogs in the attachment having teeth that are at right-angles to the machine's feed-dogs, but the cam moves the foot sideways only once at every twelfth stitch in the original version and once at every sixth stitch in the later model.

However, the folding must be done by hand and the complex attachment is simply a guide for the material.

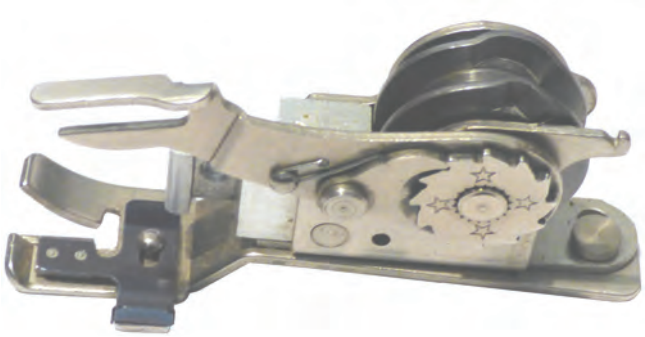


Figure 54

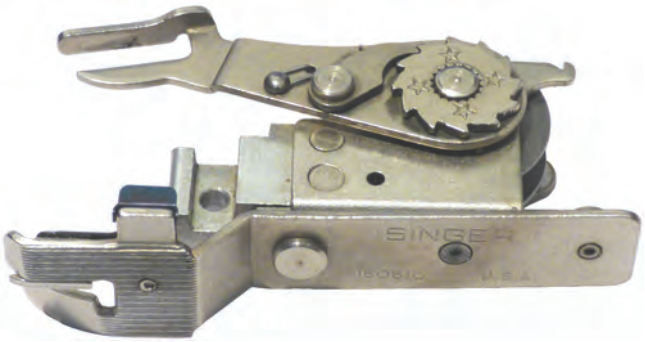



Figure 55

34 Singer, 1949.

# Singer Attachment Sets

On page 4 I have mentioned the attachment sets that Singer made and documented. Unfortunately there are very few instruction manuals before 1889 for any brand of sewing machine. But in 1889 Singer started producing separate manuals for attachments. These manuals were produced until about 1915.

The following summarises most of the known separate manuals for attachment sets, *style manuals*, followed by three machine manuals. *Reissue* manuals mean that at least one earlier manual for that style should exist. There are some variations depending on the model of the machine the set was made for, VS (vibrating shuttle with a long bobbin) or IF (improved family with a round bobbin). Sets were made for both machines but all the following illustrations up to style 14, except for style 8, are for VS machines.

At present, one attachment set is undocumented.

As I have noted before (page 4), some actual existing boxes of attachments (usually folding boxes, tins or cardboard boxes) have an assortment of attachments that do not belong together. And so I have used illustrations from manuals in preference to photographs.

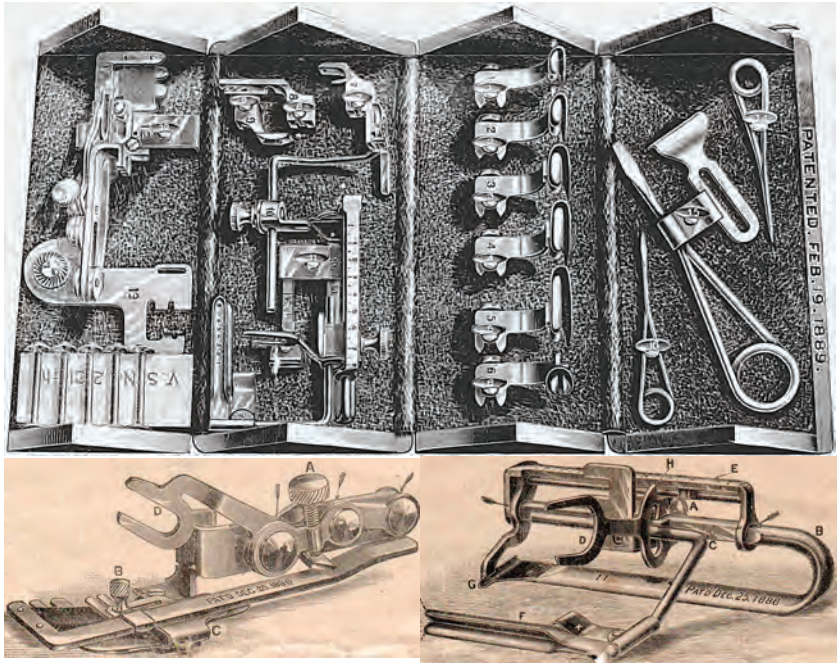
I don't know for certain, but it is a reasonable assumption that new style sets were created when there was at least one change in the container or the set of attachments. The comments highlight some of the changes.

## *Style 1: 1888*[35]

The wide-hemmers (under thumb-screws) are clamped at the back of an attachment foot. Looped screwdrivers in the accessories.

This set and the style 2 set are not described by Singer as style sets, which is not surprising as Singer probably could not predict future developments.

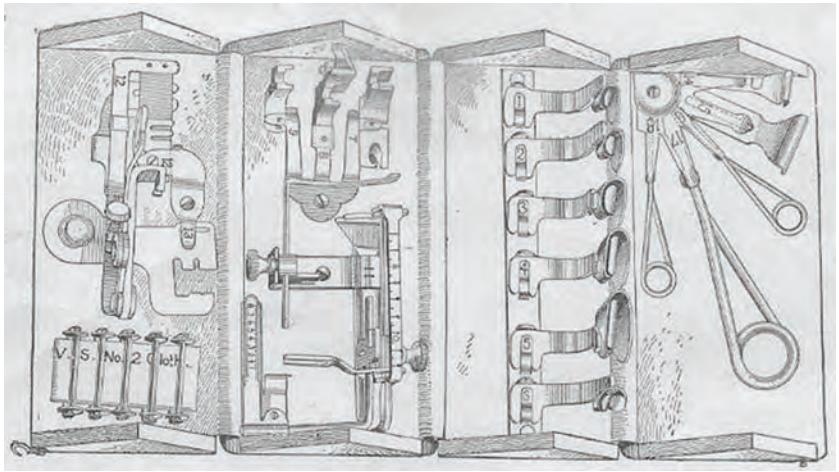
This ruffler (Figure 42, page 21) was used up to style set 8, but there may have been variants of it.




## *Style 2:* [36]

A simpler method of fixing the attachments under clips.

There is no doubt about the numbering of the Style 1 and Style 3 sets. Because of the method of clamping the wide-hemmers this set must be before Style 3 and probably dates from 1889. The attachments are the same as style 1.

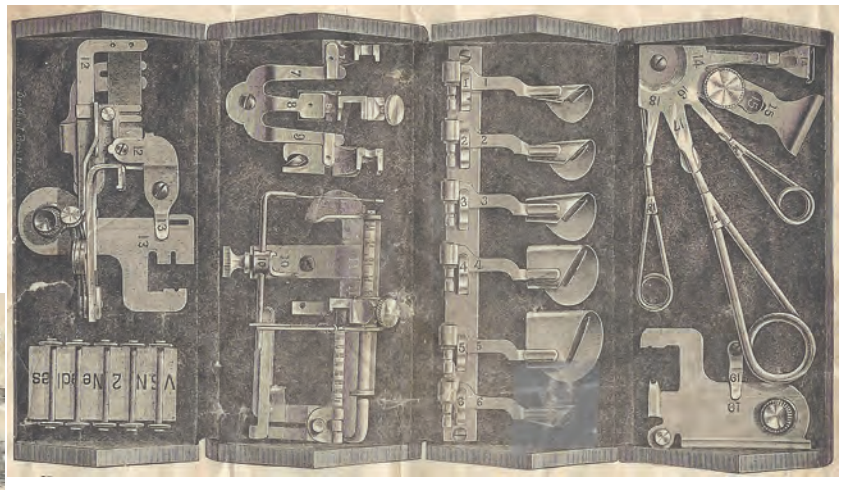


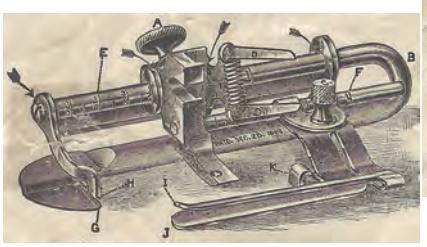
35 Singer, 1889a.
36 Singer, 1889?.

## *Style 3: 1890* [37]

Rod-clamped hemmers with a different attachment foot. Style 1 ruffler and new tuck-marker.

Addition of an under-braider and different arrangement of basic feet.

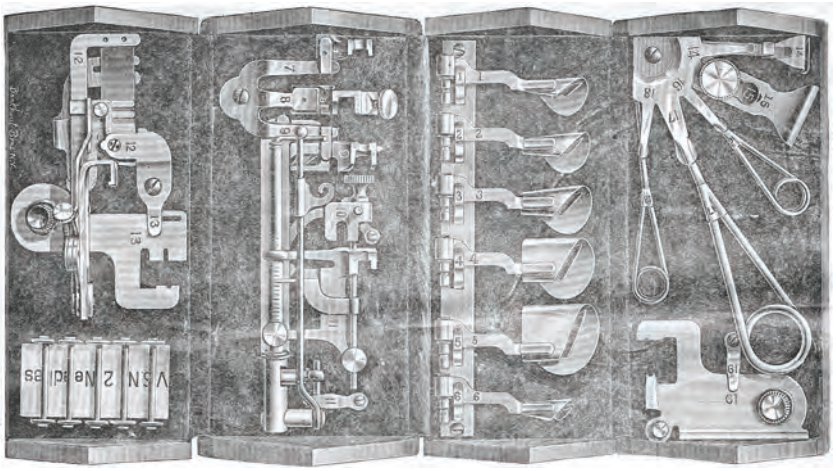


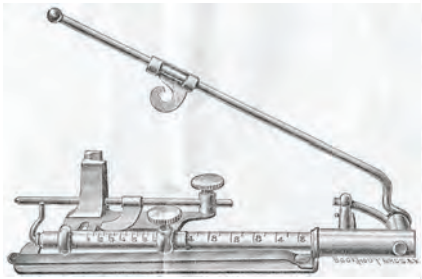


*Style sets 4, 5, and 6 are missing. As they probably fit between Style 1 in 1888 and Style 7 in 1891 they might be variants of style 1, 2 and 3, or perhaps these numbers were not used.*

## *Style 7: 1891* [38]

Style 1 ruffler and new tuck-marker.

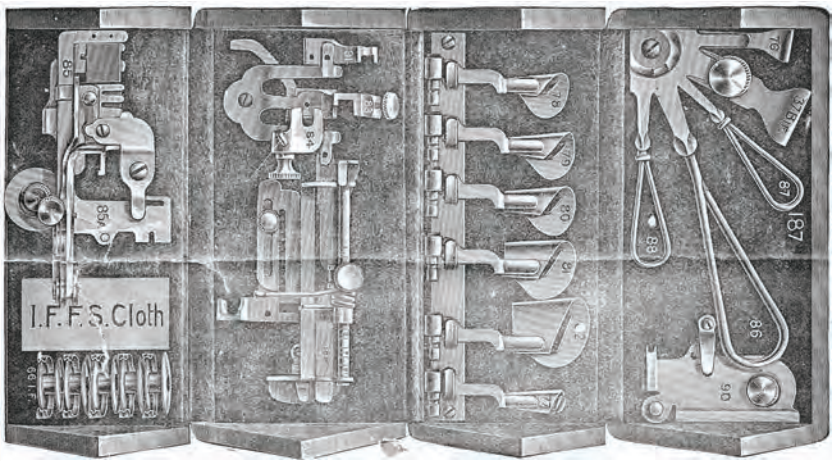


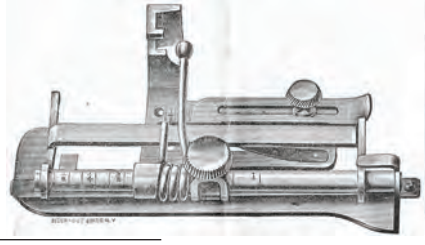


## *Style 8: 1893 reissue* [39]

Plain screwdrivers.

Style 1 ruffler, new tuck-marker. (Different under-braider, shirring plate and bobbins for the IF machine.)

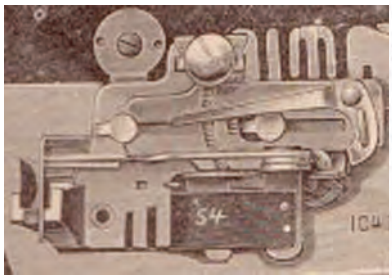


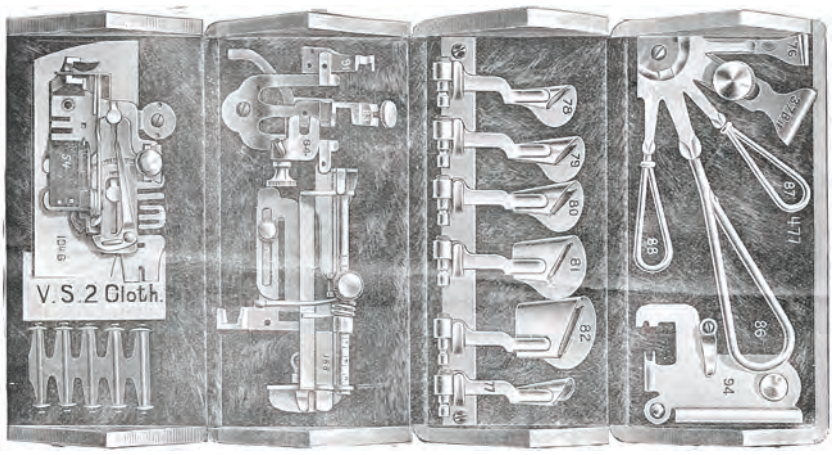



37 Singer, 1890
38 Singer, 1891a.
39 Singer, 1893a.

## *Style 9: 1893* [40]

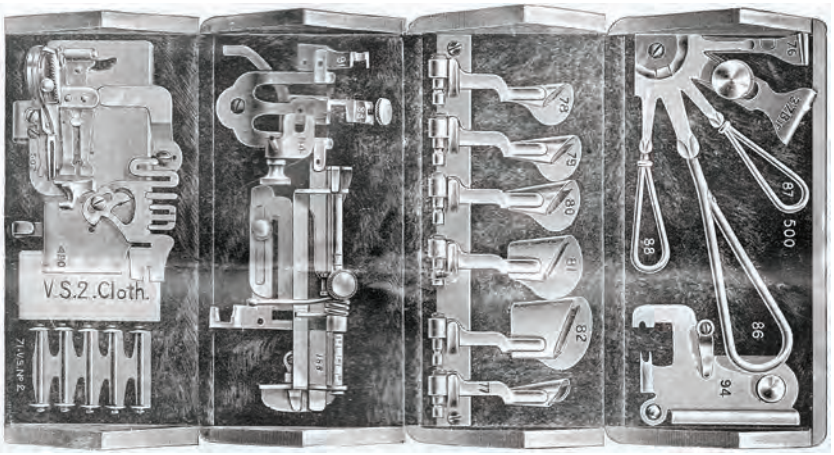
New Johnston ruffler (Figure 41b, page 21), Style 8 tuck-marker.






## *Style 10: 1895 reissue* [41]

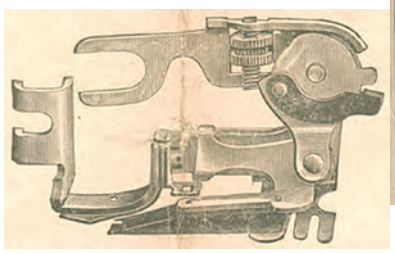
New ruffler Figures 44a to 44c page 22), and Style 8 tuck-marker.

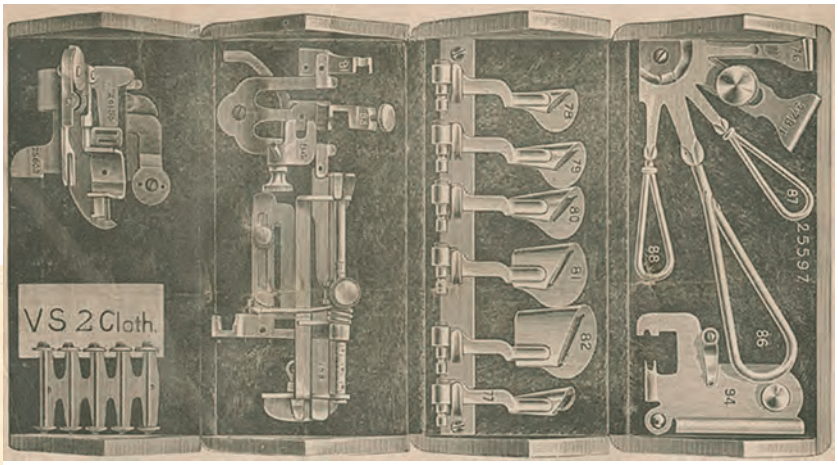



## *Style 11: 1899 reissue* [42]

New ruffler (as in Figure 40c, page 20, but with the spacer) and Style 8 tuck-marker.

Three different Style 11 sets are documented, but they are all dated after the Style 12 set!





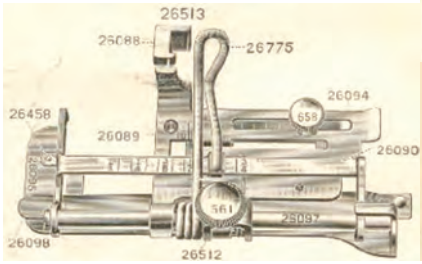

All three style 11 manuals describe a foot hemmer, but none of the box illustrations or the lists of attachments include it.

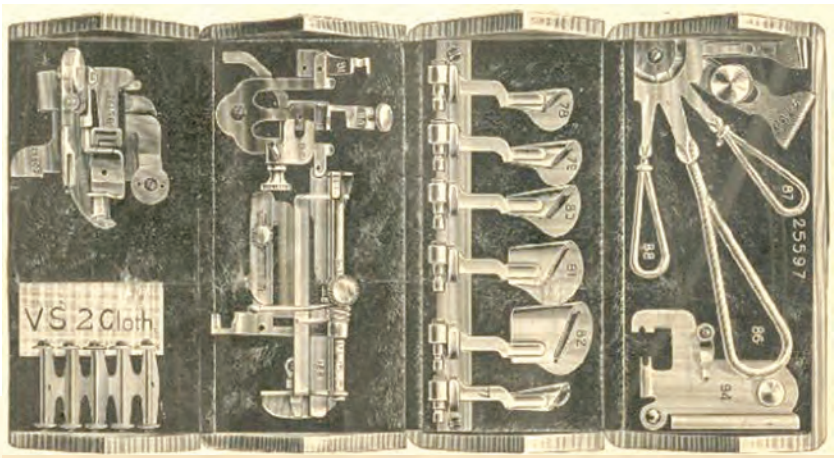
As I think it is likely that Singer produced sets chronologically this reissue suggests that there is at least one other, earlier style 11 set.

40 Singer, 1893b.
41 Singer, 1895a.
42 Singer, 1899.

## *Style 11: 1901 reissue* [43]

New tuck-marker on page 14 of the instruction manual. (The illustration on page 15 of the manual and the box view opposite show the 1899 tuck-marker, probably because the drawing was copied from the previous manual. Both are given the same number of 26513.)




**Attachments, Style No. 11, for No. 27 Machine.**

| No. | | Retail. | Old No. |
|---|---|---|---|
| 26157 | Set complete in folding box..... | $5 00 | — |
| 25597 | Box with Racks. ..... | 1 00 | 500 |

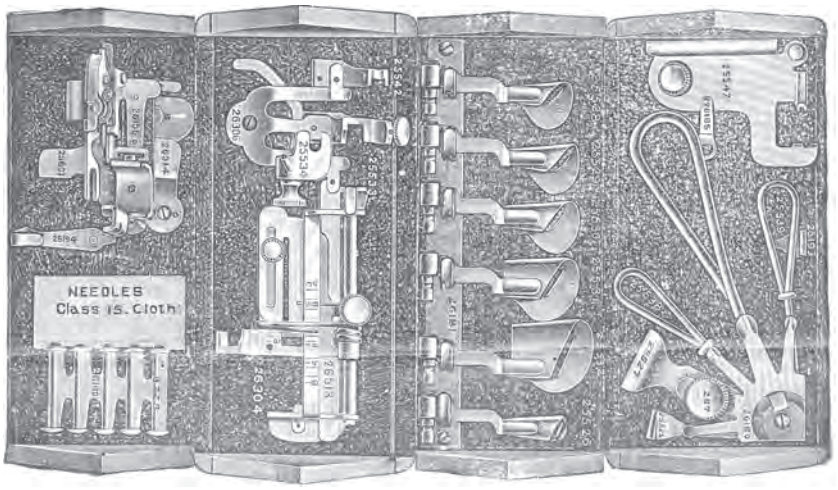
This Style manual includes a price list. A "box with racks" is the folding box with the holding clips but without any attachments or accessories.

## *Style 11: 1906 reissue* [44]

A different arrangement of the accessories (screwdrivers, and so on). Otherwise the same as the above, including the two different tuck-markers that are given the same number of 26513.

It is one of the most common folding boxes.

This Style manual has a price list.




## *Style 12: 1895 reissue* [45]

This Style manual includes a list of contents. It was supplied complete in a tin (presumably with a hinged lid) and a tin with only the racks was also available, but there are no illustrations of the tin.

The binder and 4 hemmers are bed mounted.

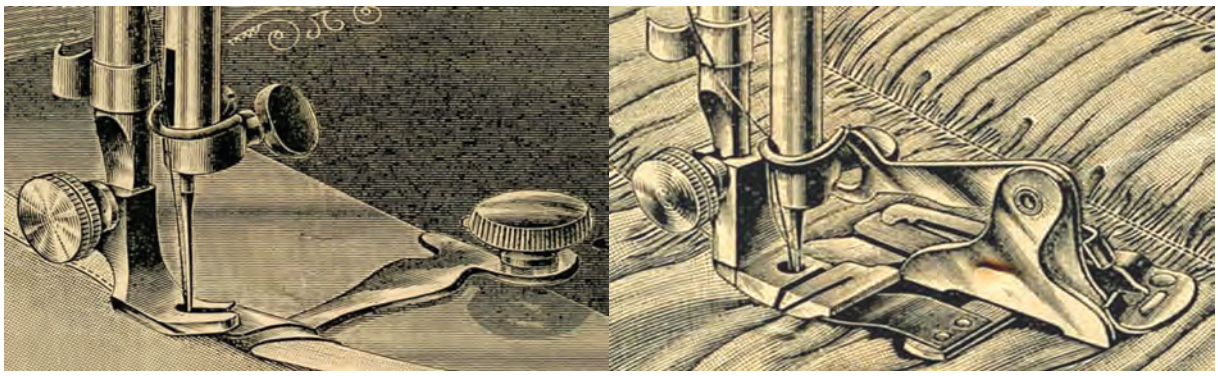
Probably a Style 9 Johnston ruffler (Figure 41b, page 21), and probably Style 7 tuck-marker.

**Attachments, Style No. 12.**

In ordering from this list be particular to give the name of the list, "A. & A."

509 Attachments, set complete, in metal box.
510 Box with Racks.

43 Singer, 1901.
44 Singer, 1906; see also Singer, ndb.
45 Singer, 1895b.



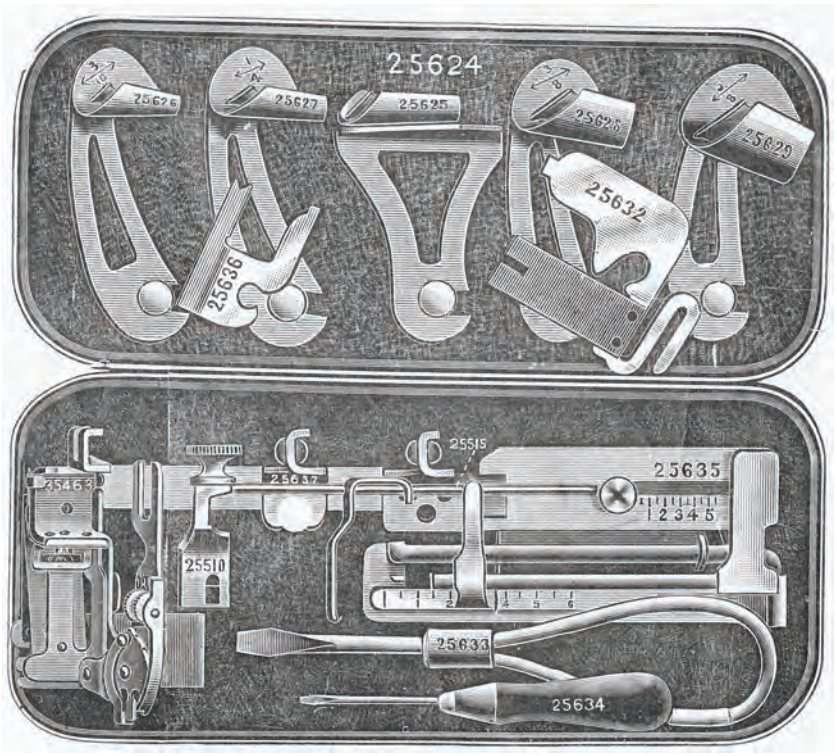
*Style set 13 is missing, perhaps because it is an unlucky number.*

## *Style 14: 1911 reissue* [46]

In a metal box with a hinged lid.

Bed mounted binder and hemmers, Style 11 ruffler (as in Figure 40c, page 20, but with the spacer) and new tuck-marker.

Made for IF and VS machines.



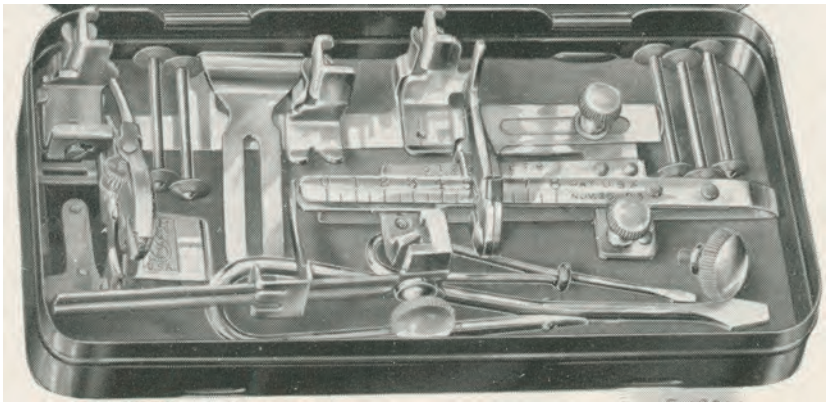

## *Style 14: 1913 reissue* [47]

This Chinese set is the same as the 1911 set.

## *Style 14: 1914* [48]

In a tin with a hinged lid (only the bottom is shown).

A few changes, but the most obvious is the new tuck-marker.



46 Singer, 1911.
47 Singer, 1913c.
48 Singer, 1914.

## *Style 15: circa 1915?* [49]

Attachments for the Model 24 chain-stitch machine.

The ruffler and tuck marker are similar to Style 11.

This manual has a price list.

Photograph provided by Ericka Officer.

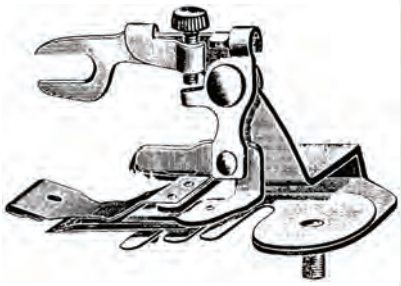
## *No Style Number: 1907* [50]

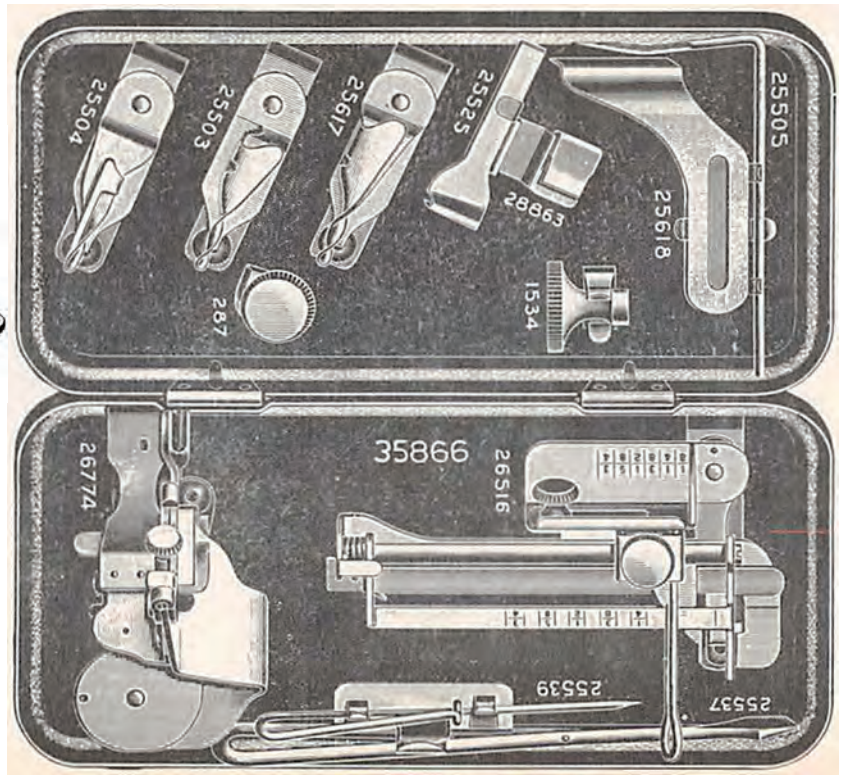
Some manuals, including one for the Model 66 machine, have the attachments in the center drawer of a treadle base.

The ruffler and tuck-marker are the same as in the 1901 Style 11 set.

## *No Style Number: 1912* [51]

The same as the Style 15 above, but a different ruffler.






## *No Style Number: 1931* [52]

The same attachment set.

49 Singer, nda.
50 Singer, 1907.
51 Singer, 1912.
52 Singer, 1931; Singer, ndc.

## *Model VS-2: 1889* [53]

This machine has wide-hemmers and a binder that are clamped at the back of an attachment foot. Most importantly it has a Johnston ruffler (Figure 41b, page 21) despite being made at the same time as Style set 1.

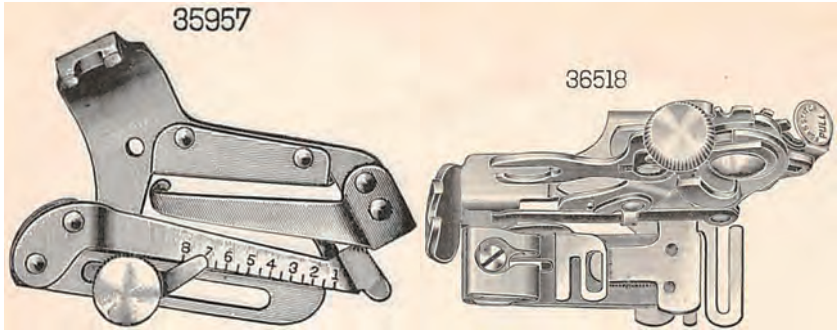
## *Model VS: 1891* [54]

The same as the VS-2 manual with Johnston ruffler and back-clamped wide hemmers.

## *Model 66: 1913.* [55]

The attachment set for this machine was in a cardboard box. It is interesting because it has an adjustable hemmer and a "1-5" stitch ruffler that is earlier than the "1-star-5" ruffler described on page 24.

The manual has a price list.




## *Undocumented Attachment Set:*

This tin has a different method of holding the attachments.

Style 10 ruffler (Figure 44, page 22) and a Style 7 tuck-marker.

Photographs by Ericka Officer.

53 Singer, 1889b.
54 Singer, 1891b.
55 Singer, 1913a; Singer 1913b.

# Financial Stress

The amount of time needed to save up for an item, or buy it on hire-purchase (used by Singer), or through a loan is a good indicator of the financial stress it causes. That is, at the rate of pay at that time, how many weeks or months or years are needed to save that amount or buy it on hire purchase? And, consequently, how much consideration must be given before deciding to purchase that item?

For example, in 1853 Wheeler and Wilson sold sewing machines for $125.[56] At that time an ordinary, unskilled worker got about $1 per day, and so the sewing machine cost about 5 month's wages. However, most of that money would be spent on necessities (like food, rent, heating, and so on), and only a small fraction was available for purchases. A reasonable guess is that at most 10% of income was discretionary and so it would take about 4 years to earn the price of the sewing machine.

In contrast, a skilled worker earned about $2 per day and it would take about 2 years to earn enough money; this is based on 25 working days in a month, 6 days per week, and allowing for 3 holidays, that is 310 days per year working.[57]

Clearly sewing machines were luxury goods at that time.

It is useful to be able to compare amounts from the past with current values. So how much would the sewing machine cost in 2019, the latest year for which data was available at the time of writing?

There are several ways in which this comparison can be made.[58] The most conservative is to use the consumer price index (CPI), in which case the sewing machine would be worth about $4,270 today.

However, at that time labour was the main component of manufactured goods such as tools (and even buildings) and comparing wages is probably a better measure than other figures; it was not until later that sophisticated machinery changed the balance and reduced costs relative to wages.

For example, initially Singer based its large-scale production of sewing machines on hand finishing non-interchangeable parts, and from 1858 "for the next fifteen years at least, ... Singer compromised with the European method by employing many cheap workmen in finishing pieces by dubious hand work ... assembling was very expensive; and after a machine was adjusted and in sewing order, all of the parts were kept by themselves ... as they were far from interchangeable."[59]

So a better comparison is to use the labour value, in which case the largely hand-made sewing machine would be worth about $59,500 today. This is because the labour in making it is very much larger than the cost of the materials. The comparison used is the production worker compensation, recognising that many of the workers were skilled.

As rates of pay are variable, one way to use this figure is to compare it with how much you earn per year and take into account the amount of disposable income you have. That is, use the amount of work then (in months) and apply it to the wages today.

The difference between the CPI and the wages measures is, in part, due to changing expectations. The worker in 1853 did not buy white-goods, cars, mobile phones, TVs, and so on, that are now considered essential, and our expectations in other areas, such as housing, have also changed. Consequently wages were relatively much lower.

ISMACS gives costs of sewing machines in the USA.[60] In 1906 a sewing machine cost about $36.80 which is about $7,310 today. This is, in fact, a measure of the improvement in manufacturing methods between 1853 and 1906. And in 1914 a Singer sewing machine, bought on hire-purchase, cost £9-9-0 or about £5,510 today.[61]

---

56 Hounshell, 1984, page 69.
57 Whaples, 2019.
58 Measuring Worth, 2020.
59 Hounshell, 1984, pages 82-123, in particular page 94; Singer, 1914, page 45; Watkins, 2020, pages 69-70
60 ISMACS, 2020.
61 Askaroff, 2019.

Although attachments are often simple, there was a lot of quite skilled work in making them. So in 1883 a hemmer took 70 operations to make and consequently was relatively expensive.[62]

Figure 56 is a 1906 price list, but the prices were constant from at least 1901.[63] At that time a folding box with attachments retailed for $5, which is about $993 now. The box itself cost $199 and so the complete set of attachments and accessories was valued at $794.

And a set of hemmers with their attachment foot cost $1.15, about $228 now, and a ruffler cost $0.65, about $129 now.

**Attachments, Style No. 11, for No. 27 Machine.**

| No. | | Retail | U. S. Postage |
|---|---|---|---|
| 26157 | Set complete in folding box | $5 00 | — |
| 25597 | Box with Racks | 1 00 | — |
| 25525 | Bias Gauge | 10 | 01 |
| 25526 | Binder | 15 | 01 |
| 25527B | Cloth Guide | 10 | 02 |
| 287 | " " Thumb Screw | 10 | 01 |
| 25528 | Hemmer, $\frac{3}{16}$ in. hem | 15 | 01 |
| 25529 | " $\frac{1}{4}$ " " | 15 | 02 |
| 25530 | " $\frac{3}{8}$ " " | 15 | 02 |
| 25531 | " $\frac{5}{8}$ " " | 15 | 02 |
| 25532 | " $\frac{7}{8}$ " " | 15 | 02 |
| 25533 | " Foot with Screw No. 291 | 40 | 02 |
| Class 15 | Needles, in packages of three | 05 | 01 |
| 25534 | Quilter | 20 | 02 |
| 26158 | Ruffler No. 26156 with Shirring Plate No. 25603 | 75 | 03 |
| 26156 | " for Shirring Plate | 65 | 03 |
| 25603 | " Shirring Plate | 10 | 01 |
| 25537 | Screw Driver (Machine) | 10 | 03 |
| 25538 | " " (Shuttle Tension) | 05 | 01 |
| 8228 | Shuttle Bobbin, each | 05 | 01 |
| 25539 | Stiletto | 05 | 02 |
| 26513 | Tucker | 75 | 05 |
| 25547 | Under Braider | 25 | 02 |
| 25542 | Braider Foot | 15 | 01 |

Figure 56

62 Fitch, 1883, page 653.

63 Singer, 1906.

# References


American Sewing Machine, circa 1880, *The New American Sewing Machine*.

Askaroff, Alex, 2019, *The Singer 201*, https://sewalot.com/singer_201k_sewalot.htm and https://www.youtube.com/watch?v=dBXWzJGXlX8.

Bacle, D, circa 1888, *Pedale Magique Bacle*, https://www.victoriansweatshop.com/?forum=626056

Boye Needle Co., 1909, *"Boye" Guide, Encyclopedic in Character and Thoroughness of its Information Concerning the Sewing Machine*, https://www.victoriansweatshop.com/post/singer-puzzle-boxes-and-manuals-from-canada-10466294?&trail=100

Fiddlebase, 2020, *Greist Manufacturing Company*, https://www.fiddlebase.com/american-machines/greist-manufacturing-company/greist-mfg-company-u-s-patent/

Fitch, Charles H., 1883, *Manufactures of Interchangeable Mechanism*, in *Report on the Manufactures of the United States at the Tenth Census June 1 1880*, Volume 2, pages 611-704.

Greist, John M., 1897, *Sewing-Machine Ruffler*, https://patentimages.storage.googleapis.com/65/43/02/ef2555a34fa746/US587257.pdf

Griest, John M., 1889, *Box*, United States Patent Office, https://patentimages.storage.googleapis.com/c8/f8/4d/08aacc984c4333/US397980.pdf

Greist, John M., 1901, *Ruffling Attachment for Sewing Machines*, https://patentimages.storage.googleapis.com/9e/5e/21/65c68c99b3846f/US665519.pdf

Hounshell, David, 1984, *From the American System to Mass Production 1800-1932*, John HopkinsUniversity Press.

ISMACS, 2020, *Singer Manufacturing Dates and Average Cash Cost*, http://ismacs.net/singer_sewing_machine_company/singer_manufacture_dates_by_serial_number.html

Johnston, Allen, 1873, *Improvement in Gathering or Ruffling Attachments for Sewing-Machines*, United States Patent Office, https://pdfpiw.uspto.gov/.piw?PageNum=0&docid=00135123&IDKey=D485F6C144C8&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetahtml%2FPTO%2Fpatimg.htm

Johnston, A., 1886, *Ruffling and Gathering Attachment for Sewing Machines*, United States Patent Office, No. 349,279.

Measuring Worth, 2020, https://www.measuringworth.com/calculators/uscompare/

Needlebar, 2020a, *Singer Attachment Boxes*, http://needlebar.org/main/puzzles/index.html.

Phillips, Charlene, 2008, *Singer Attachment Case - Puzzle Box - Style 1*, http://www.thesewbox.com/2008/10/singer-attachment-case-puzzle-box-style.html

Singer, 1889a, *Directions for Using the Singer Manufg. Co.'s 1888 (Foot Bar) Set of Attachments with the Improved Family or the Vibrating Shuttle No. 2 Sewing Machines*, https://www.manualslib.com/manual/987675/Singer-1888-Foot-Bar-Set-Of-Attachments.html

Singer, 1889b, *Directions for Using the Vibrating Shuttle No. 2 Singer Sewing Machine*, see Stuart, 2020. (Also available in German at https://www.sil.si.edu/DigitalCollections/Trade-Literature/Sewing-Machines/NMAHTEX/1762/index.htm)

Singer, 1889?, *A Complete Set of 18 of the Latest and Best Attachments*, http://needlebar.org/nbwiki/index.php/Ericka#Singer_Improved_Family_Puzzle_Box_Layout

Singer, 1890, *Directions for Using the Singer Manufacturing Co.'s Attachments Style No. 3*, https://www.sil.si.edu/DigitalCollections/Trade-Literature/Sewing-Machines/NMAHTEX/0672/index.htm

Singer, 1891a, *Directions for Using the Singer Manufacturing Co'.s Attachments Style No. 7*, http://needlebar.org/nbwiki/index.php/Ericka#Singer_Style_7_Box_Manual (see also https://www.pinterest.ca/pin/332210910010547654/?nic_v1=1aiT3a29BqGAkIAYJtaOM5plOljXmPtEabJ%2FIy1gsxx4N8UYW963mFTr27yCYprZO5)

Singer, 1891b, *Directions for Using the Singer Mfg. Co'.s Vibrating Shuttle Sewing Machine*, http://ismacs.net/singer_sewing_machine_company/manuals/singer-sewing-machine-vibrating-shuttle-manual-1891.pdf

Singer, 1893a, *Directions for Using the Singer Manufacturing Co's Attachments Style No. 8*, http://needlebar.org/nbwiki/index.php/Ericka#Singer_Style_8_Box_Manual

Singer, 1893b, *Instructions for Using the Singer Manufacturing Co'.s Attachments Style No. 9*. (Provided by Ericka Officer.)

Singer, 1895a, *Instructions for Using the Singer Manufacturing Co'.s Attachments Style No. 10*. (Provided by Ericka Officer.)

Singer, 1895b, *Instructions for Using the Singer Manufacturing Co'.s Attachments Style No. 12*, https://www.victoriansweatshop.com/post/singer-puzzlebox-manual-12-10586652?pid=1311952808

Singer, 1896, *Instructions for Using the Singer Manufacturing Co'.s Attachments for Singer Sewing Machines*. (Provided by Ericka Officer.)

Singer, 1899, *Directions for Using the Singer Manufacturing Co.'s Attachments Style No. 11*, http://www.treadleon.net/sewingmachineshop/atttachmentsmanual/attachments.html.

Singer, 1901, *Directions for Using the Singer Manufacturing Co.'s Attachments Style No. 11*, http://www.treadleon.net/sewingmachineshop/atttachmentsmanual/attachments.html.

Singer, 1906, *Instructions for Using the Singer Manufacturing Co'.s Attachments Style No. 11 for No. 27 Machine*. (Provided by Ericka Officer.)

Singer, 1907, *Instructions for Using the Singer Manufacturing Co'.s Attachments with No. 27-4 Sewing Machine*, https://www.etsy.com/listing/101670830/1907-singer-treadle-sewing-machine

Singer, 1908, *Instructions for Using the Singer Manufacturing Co'.s 27K and 28K (Vibrating Shuttle) Sewing Machines*. (Provided by Megan Mills.)

Singer, 1911, *Instructions for Using Attachments Style No. 14 with Singer Sewing Machines Nos. 15, 27 and 28.* (Provided by Ericka Officer.)

Singer, 1912, *Instructions for Using Singer Sewing Machine No. 24-50 Automatic Chain Stitch and Attachments*. (Provided by Ericka Officer.)

Singer, 1913a, *Instructions for Using the Singer Sewing Machine No. 66-1*, https://ia800605.us.archive.org/24/items/Singer661Manual/Singer_66-1_Manual.pdf

Singer 1913b, *Illustrated Price List of Parts for Class 66K Machines*, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXpvOAt9DqAhVwH7cAHYlVCi4QFjAKegQIBRAB&url=https%3A%2F%2Fwww.supsew.com%2Fdownload%2FSinger%2FSinger%252066K2%2C%2520K3.pdf&usg=AOvVaw0Ba7C0phCKdqTqvmiYriqO

Singer, 1913c, *Chinese Instructions for Using Attachments with Singer Sewing Machines*, https://www.sil.si.edu/DigitalCollections/Trade-Literature/Sewing-Machines/NMAHTEX/1758/imagepages/image1.htm.

Singer, 1914, *Instructions for Using Attachments Style No. 14*, https://www.sil.si.edu/DigitalCollections/Trade-Literature/Sewing-Machines/NMAHTEX/2663/imagepages/image1.htm

Singer, 1931, *Price List of Parts for Family Shops Machines Nos. 24-60 to 24-63 and 24-65 to 24-67*, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjO4Jnd6s3qAhVVWH0KHSmUC0EQFjAAegQIBhAB&url=https%3A%2F%2Fwww.supsew.com%2Fdownload%2FSinger%2FSinger%252024-68%2C%2520-69.pdf&usg=AOvVaw0X8b7_cVbynBfYwyEkPR1n

Singer, 1949, *Blind Stitch Attachment*, http://ismacs.net/singer_sewing_machine_company/manuals/singer-blindstitch-attachment-manual.pdf

Singer, 1951, *Instructions for using Singer Sewing Machines 15-88 and 15-89*, https://www.singer.com/sites/default/files/outdated_product/SINGER%2015-88_15-89%20and%2015-90%20Sewing%20Machines.pdf (see also https://www.sil.si.edu/DigitalCollections/Trade-Literature/Sewing-Machines/NMAHTEX/2665/imagepages/image1.htm)

Singer, 1953, *Walking Presser Foot 160741*, Singer Manufacturing Company. https://cdn.shopify.com/s/files/1/0992/8814/files/Walking_Foot_Manual.pdf?12408179749315364980.

Singer, nda, *Instructions for Using the Singer Manufacturing Co.'s Attachments for the Singer Chain Stitch Sewing Machine*, https://www.victoriansweatshop.com/post/model-24-manual-and-puzzle-box-instructions-10574070?pid=1311826383

Singer, ndb, *Price List of Parts No. 27 Machines for Family Use*, https://web.archive.org/web/20060314060240/http://parts.singerco.com/IPpartCharts/27-1_2_3_4.pdf

Singer, ndc, *Price List of Parts for Family Shops Machines Nos. 24-68 and 24-69*, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi9iPap7s3qAhWjwTgGHc7kD8IQFjADegQIARAB&url=https%3A%2F%2Fwww.supsew.com%2Fdownload%2FSinger%2FSinger%252024-68%2C%2520-69.pdf&usg=AOvVaw0X8b7_cVbynBfYwyEkPR1n

Singer Sewing Info, 2020a, *Singer 206 Sewing Machines*, https://www.singersewinginfo.co.uk/206/

Singer Sewing Info, 2020b, *Singer Simanco 25509 Hemmer*, https://www.singersewinginfo.co.uk/simanco/25509/.

Singer Sewing Info, 2020c, *Singer 66 and 66K Sewing Machines*, https://www.singersewinginfo.co.uk/66/.

Smithsonian Institution Libraries, 2001, *Sewing Machines, Historical Trade Literature in the Smithsonian Institutions Collections*.

Smithsonian Institution Libraries, 2020, https://www.sil.si.edu/DigitalCollections/Trade-Literature/Sewing-Machines/CF/

Stuart, John, 2020, *Photographs*, https://www.flickr.com/photos/132113927@N03/page1 and https://www.victoriansweatshop.com/post/singer-puzzlebox-manual-12-10586652?pid=1311952808

Victor, circa 1880, *Directions for Using the New Sewing Machine "Victor"*, see Smithsonian Institution Libraries, 2020.

Victorian Sweatshop Forum, 2020a, *Sewing Machine Manuals*, https://www.victoriansweatshop.com/?forum=626056

Victorian Sweatshop Forum, 2020b, *Singer Puzzle Boxes and Manuals from Canada*, https://www.victoriansweatshop.com/post/singer-puzzle-boxes-and-manuals-from-canada-10466294?&trail=50

Warren, John, 2020, *Antique Sewing Machines, the Four Motion Feed*, http://teahippo.uk/oldsewingmachines/works2.html

Watkins, 2020, *Watchmaking, the American System of Manufacturing and Mass Production*, http://www.watkinsr.id.au/amsystem.html

Whaples, Robert, 2019, *Hours of Work in U.S. History*, https://eh.net/encyclopedia/hours-of-work-in-us-history/

Wheeler & Wilson, ca 1876, *Instructions for Using Wheeler & Wilson's New Family Sewing Machine No 8*, http://ismacs.net/wheelerandwilson/manuals/wheeler-and-wilson-number-8-manual.pdf.

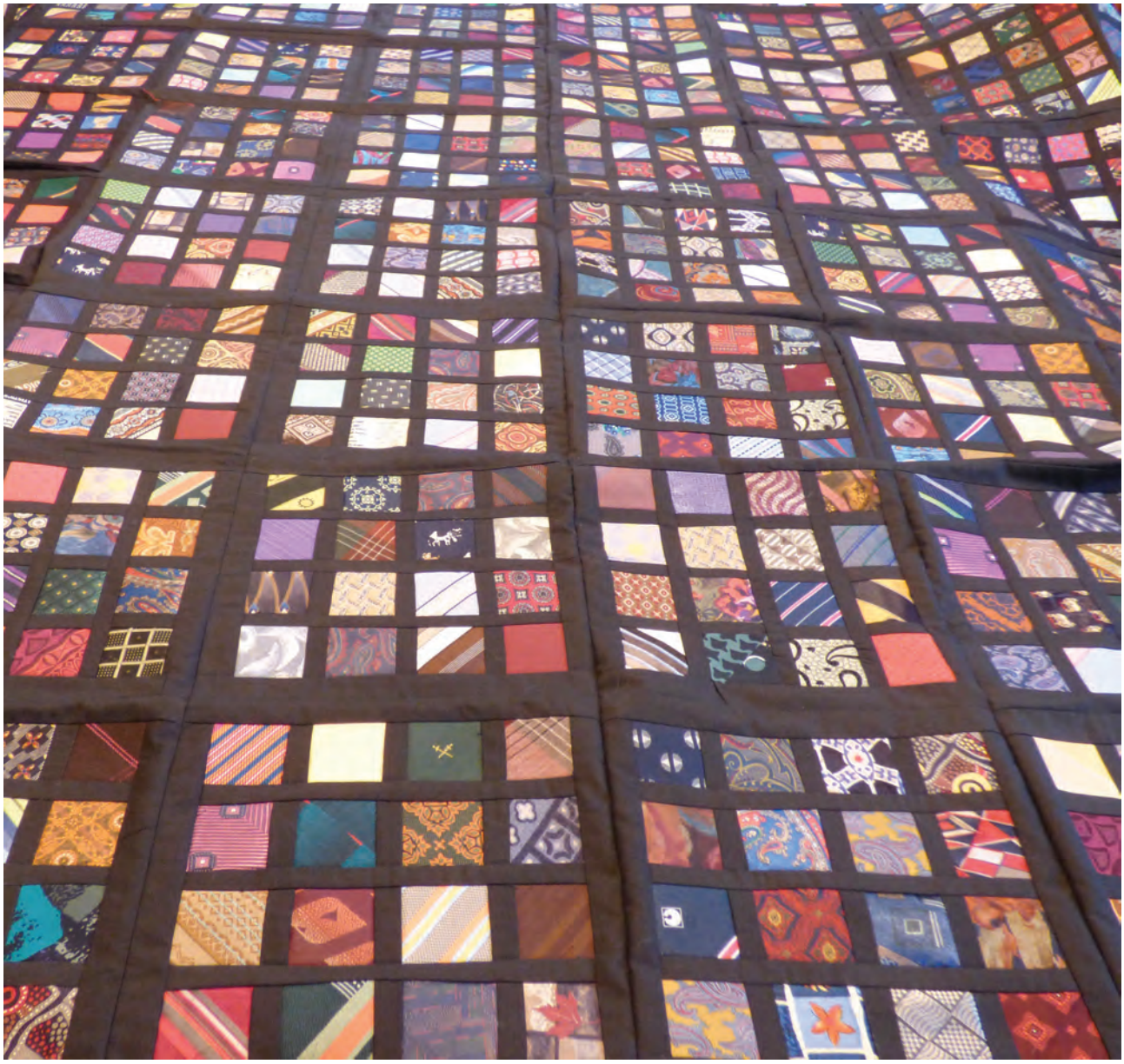
Wheeler & Wilson, ca 1888, *Directions for Using the Wheeler & Wilson "No. 9" New Family Sewing Machine* http://www.sewmuse.co.uk/Wheeler%20&%20Wilson%20No%209%20Manual.pdf

Wikipedia, 2019b, *Sewing Machine*, https://en.wikipedia.org/wiki/Sewing_machine.

Wikipedia, 2020a, *Singer Model 27 and 127*, https://en.wikipedia.org/wiki/Singer_Model_27_and_127.

Wikipedia, 2020b, *Singer Puzzle Box*, https://web.archive.org/web/20160426023323/https://en.wikipedia.org/wiki/Singer_puzzle_box

Williams, nd, *Instructions for Using the New Williams Sewing Machines and Attachments*, http://www.needlebar.org/main/manuals/newwilliams/4index.html



Part of an un-ironed window hanging made from men's ties. There are 9 x 8 large squares comprised of 1,152 small squares cut from different ties. It is meant for the light of the Sun to shine through it.

Made with a Singer 201K treadle sewing machine and assembled with a Janome foot holder and a Janome ¼ inch seam foot on the same machine.