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]

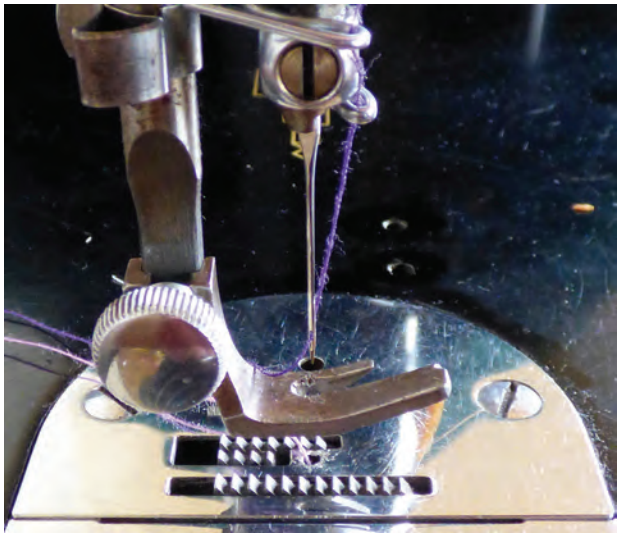

Figure 1

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

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

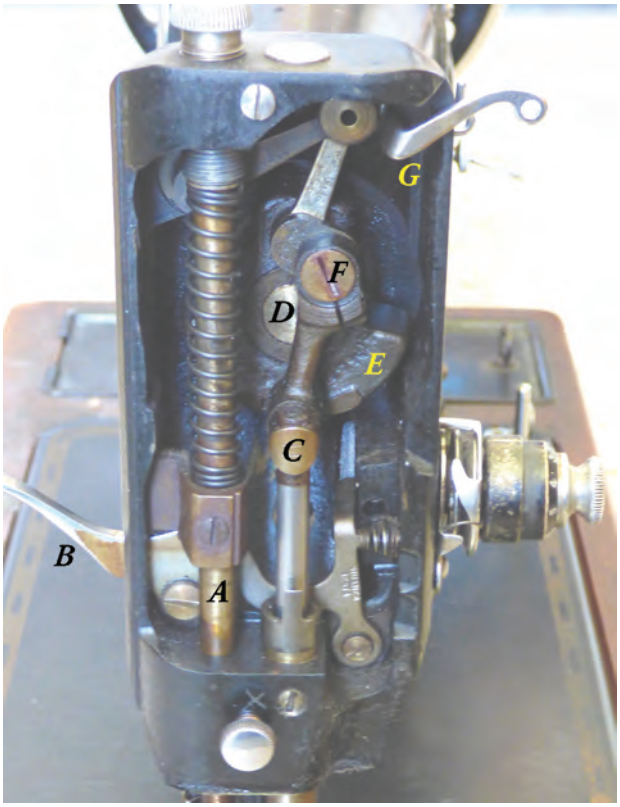

Figure 2

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.

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.

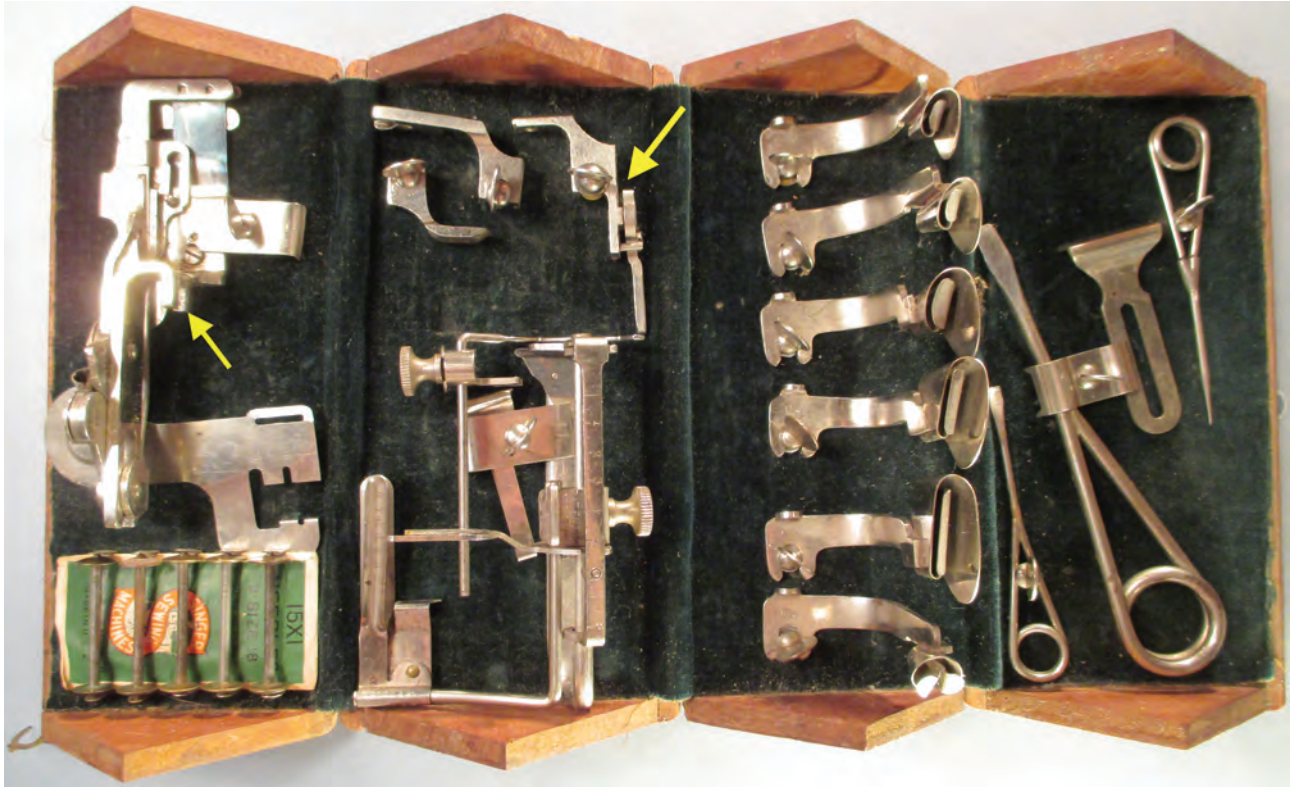

Figure 3

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]

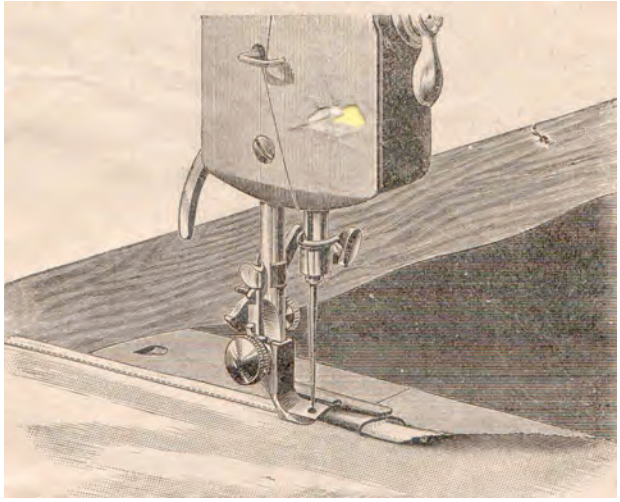

Figure 6

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]

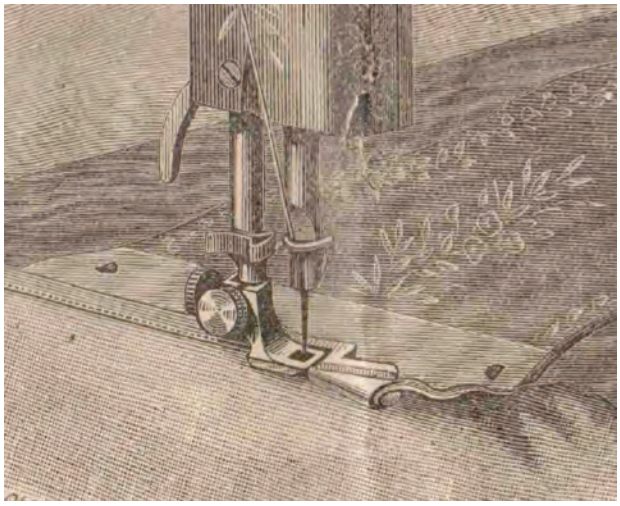

Figure 7

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.

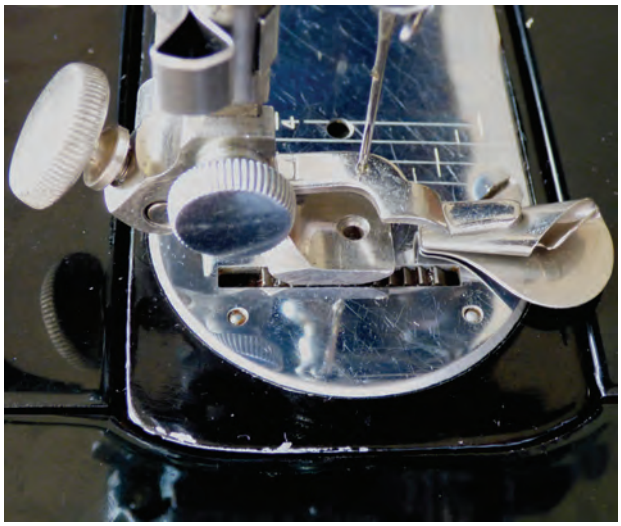

Figure 8

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.

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!

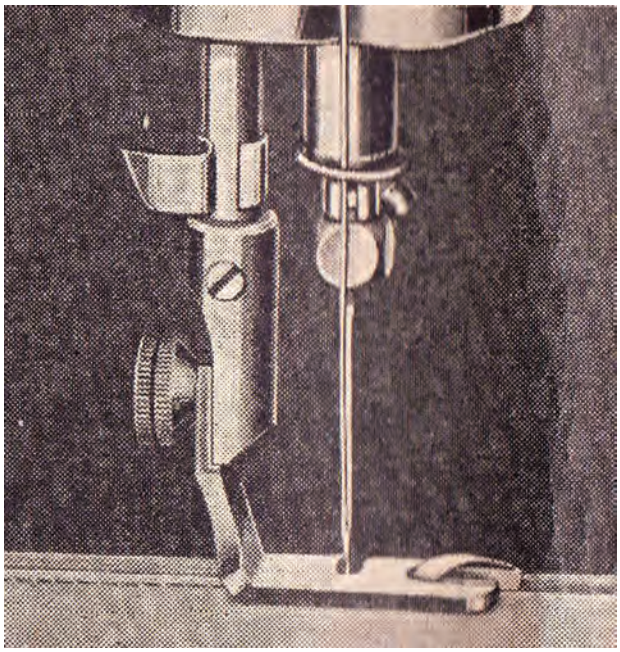

Figure 10

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.

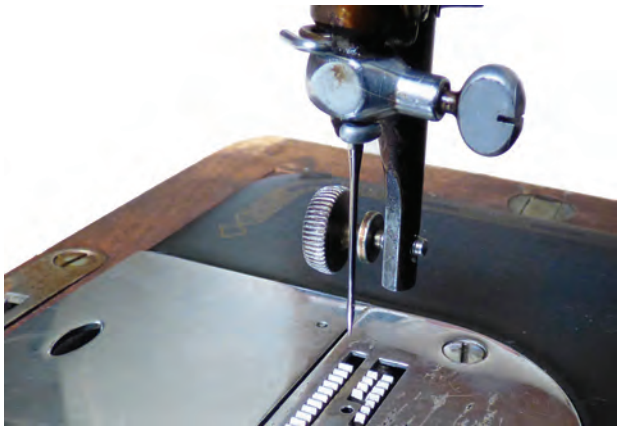

Figure 12

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.

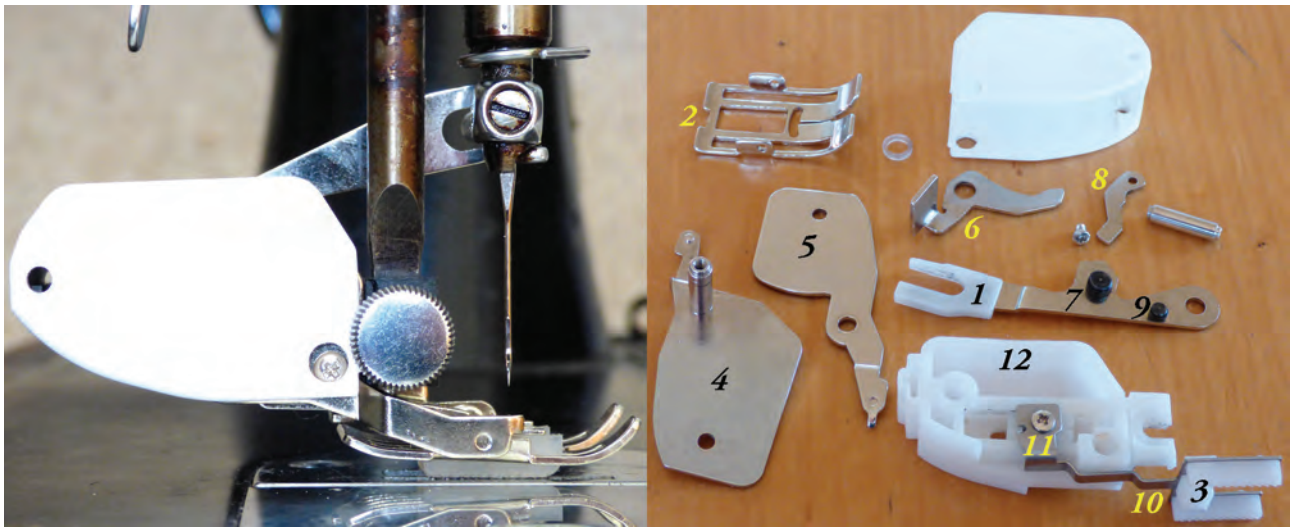

Figure 13

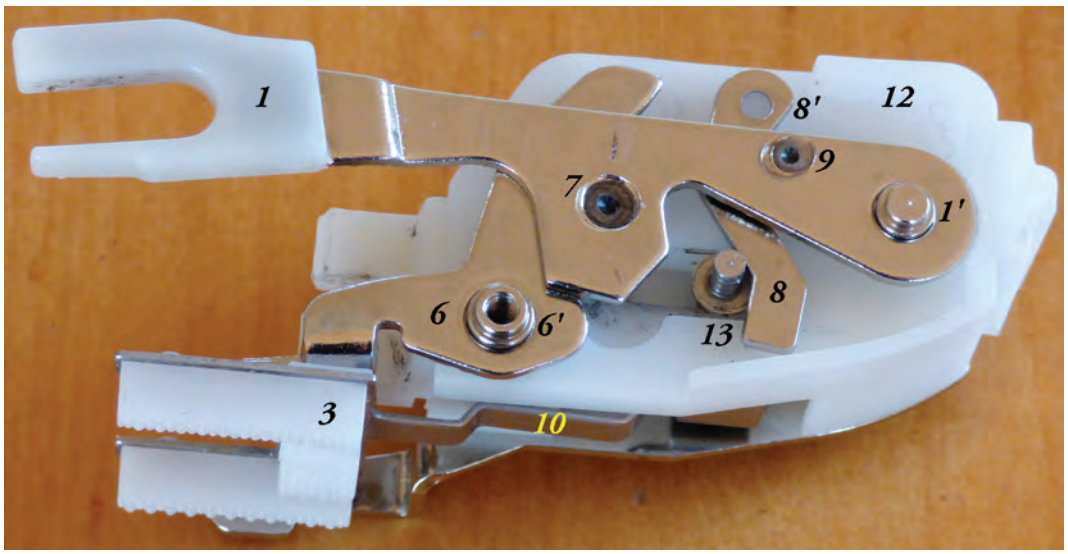

Figure 14

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***.

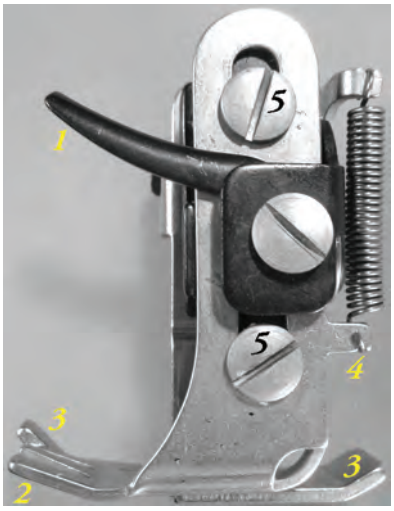

Figure 15a (Ericka Officer)

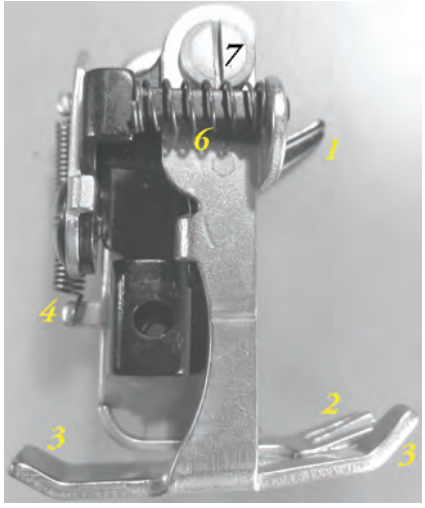

Figure 15b (Ericka Officer)

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.

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.

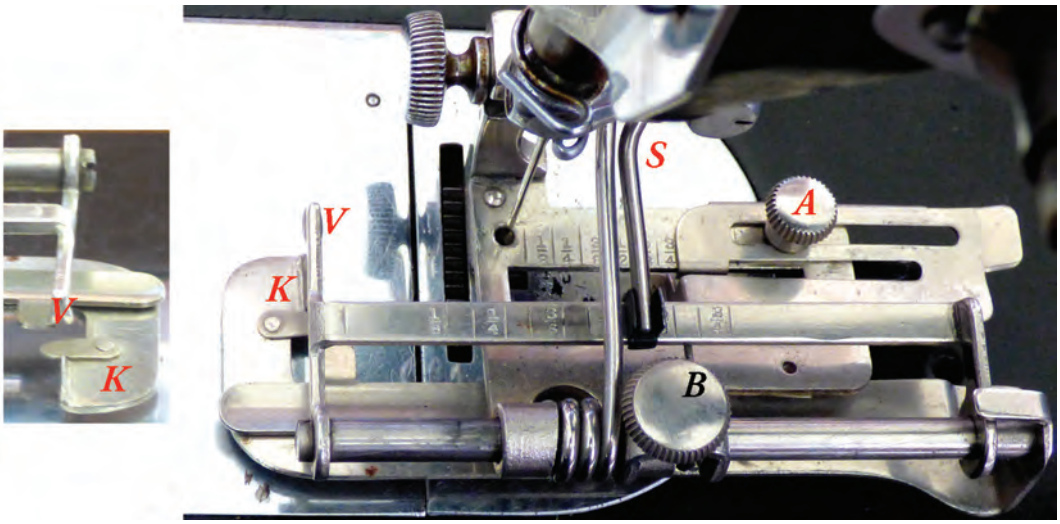

Figure 16

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.

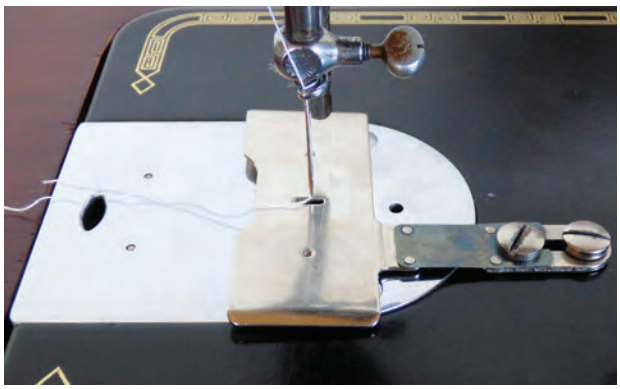

Figure 18

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.

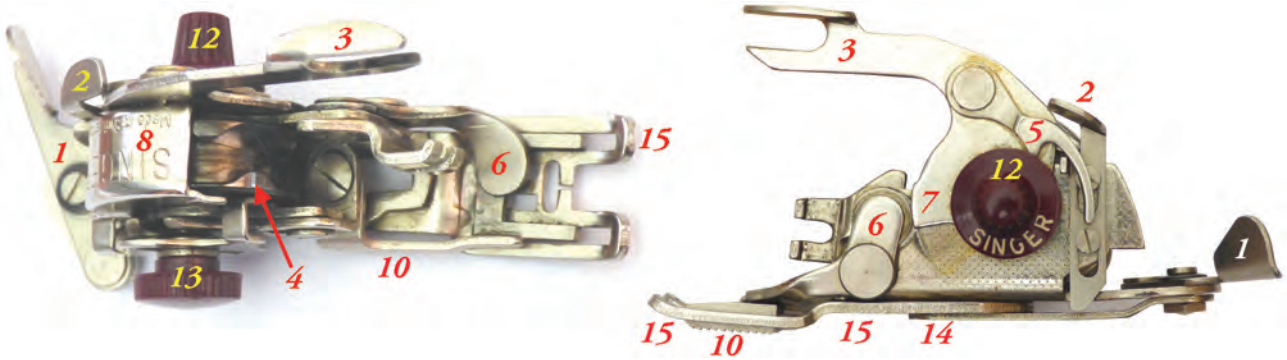

Figure 19

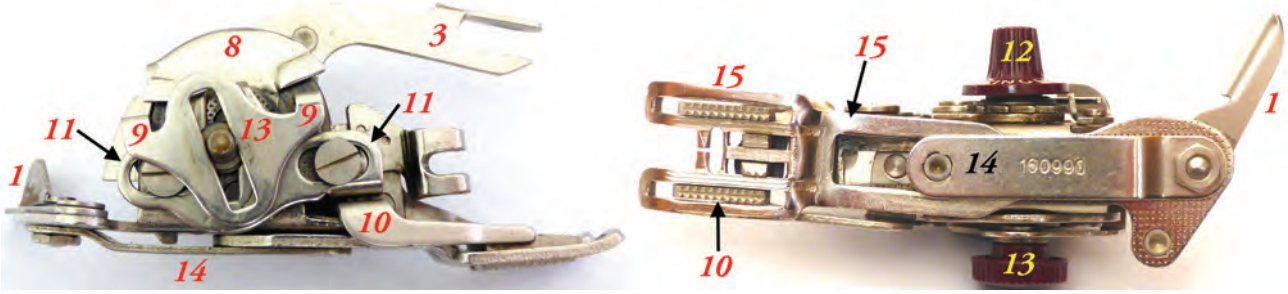

Figure 20

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.

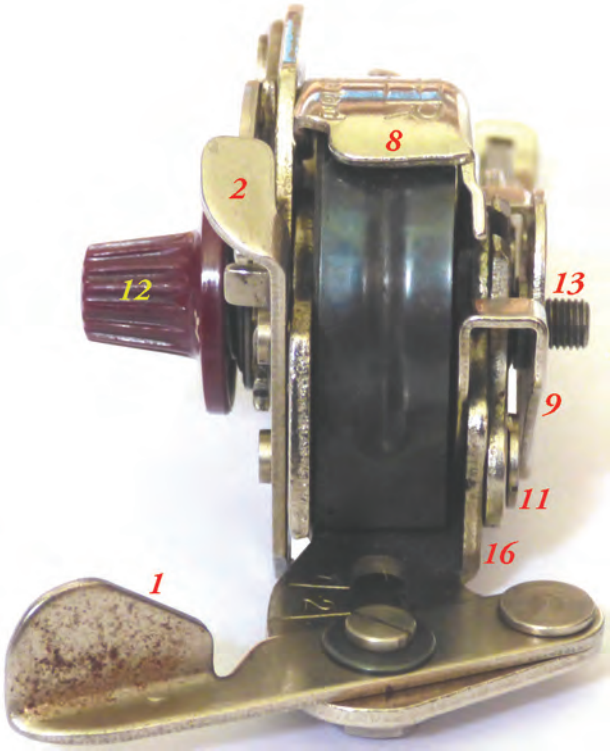

Figure 22

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.

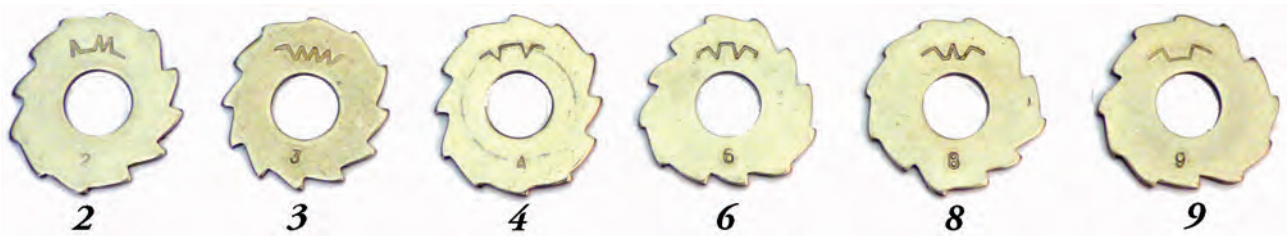

Figure 23

Figure 24

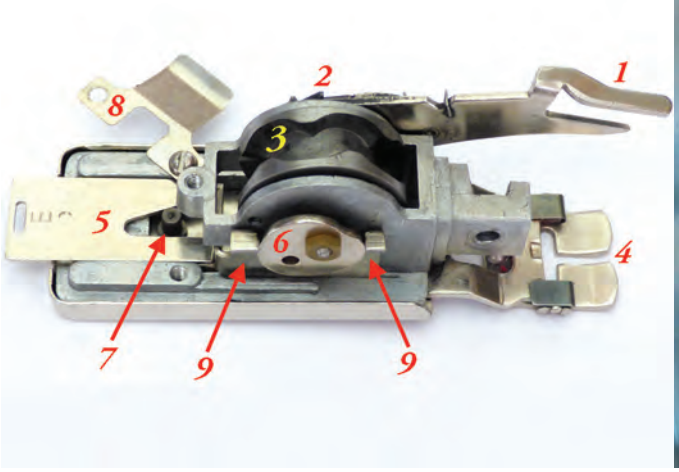

Figure 25a

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.

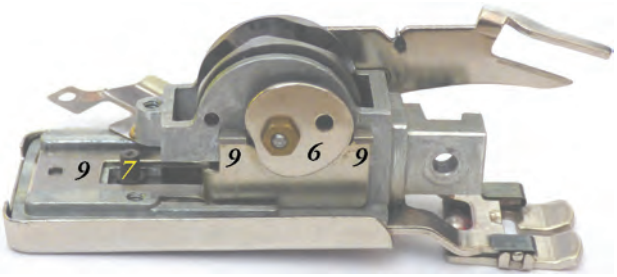

Figure 26

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.

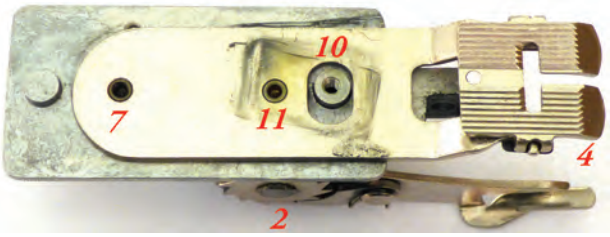

Figure 27

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.