Domestic Sewing Machine Presser-Feet

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I would like to thank Wolfegang's Collectibles and Steven Heeter for giving permission to reproduce photographs, 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.

The emphasis on Singer machines is the result of what I have available to me.

Introduction

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 is the *presser-foot*. With the normal presser-foot the machine can only sew in a straight line. However, there are presser-feet that adapt the sewing machine to sew in sophisticated ways.

Although there are many instructions on how to *use* presser-feet, 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 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 is in use now, nearly every day, by a person who was also born in 1936.

What should be clear 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 two obvious parts that need to be interchangeable, the needle and the thread.

A third part, the bobbin, is interchangeable because it is convenient to have more than one bobbin with different coloured threads. *Nothing else needs to be interchangeable because nothing else needs to be replaced.*

1 Askaroff, 2019.

Simple Presser-Feet

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* above the material presses it firmly onto the saw-tooth *feed-dogs* in the base of the machine. The feed-dogs 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]

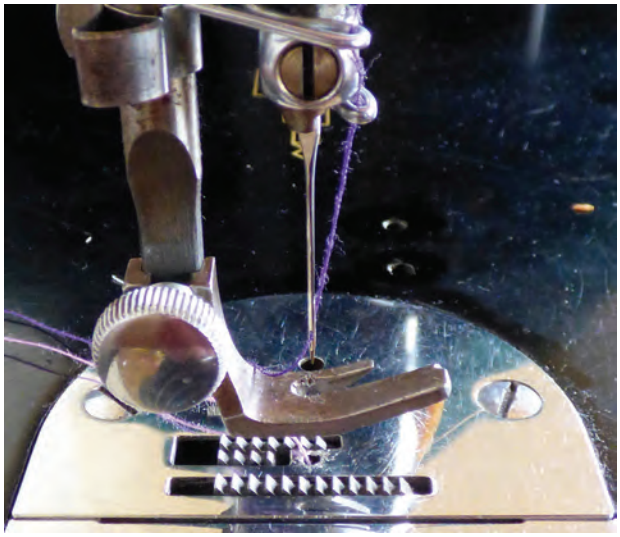

Figure 1

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*** controls the presser-foot; the lever ***B*** on the outside raises it, as in Figure 1. It is free but held down by a spring.

The center rod ***C*** 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.

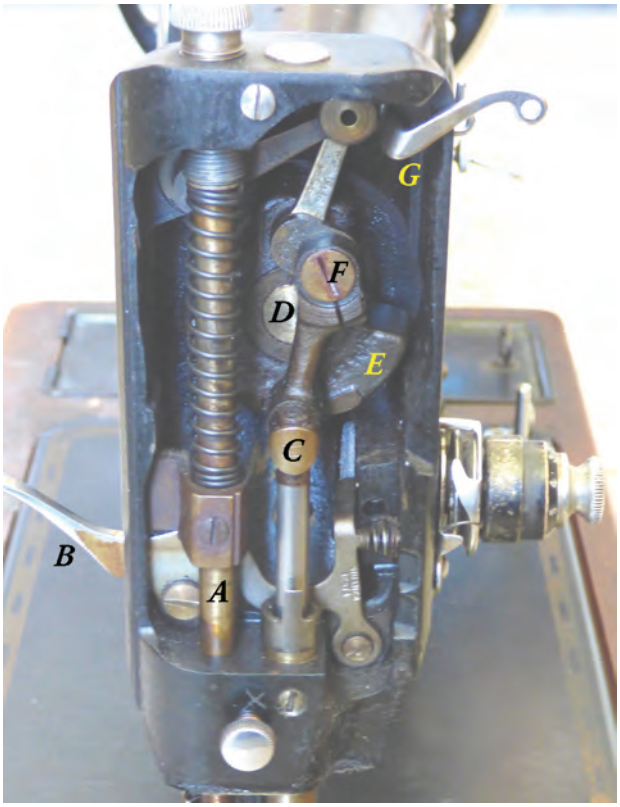

Figure 2

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 the 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 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 rod and cannot be removed. And other designs appear to have the 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 sewing machine presser-feet. This is because from about 1888 Singer produced *style boxes* which held a set of presser-feet; these style boxes are commonly called *puzzle boxes* because of the way they unfold.[4] The majority of these were produced in the 19th century because the style 11 box is dated 1901.[5] It retailed for $5, about $1,150 now. A summary of these boxes is given on page 18.

Figure 3 is a style 1 box dated 1888,[6] and Figure 4 is probably a style 12 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.

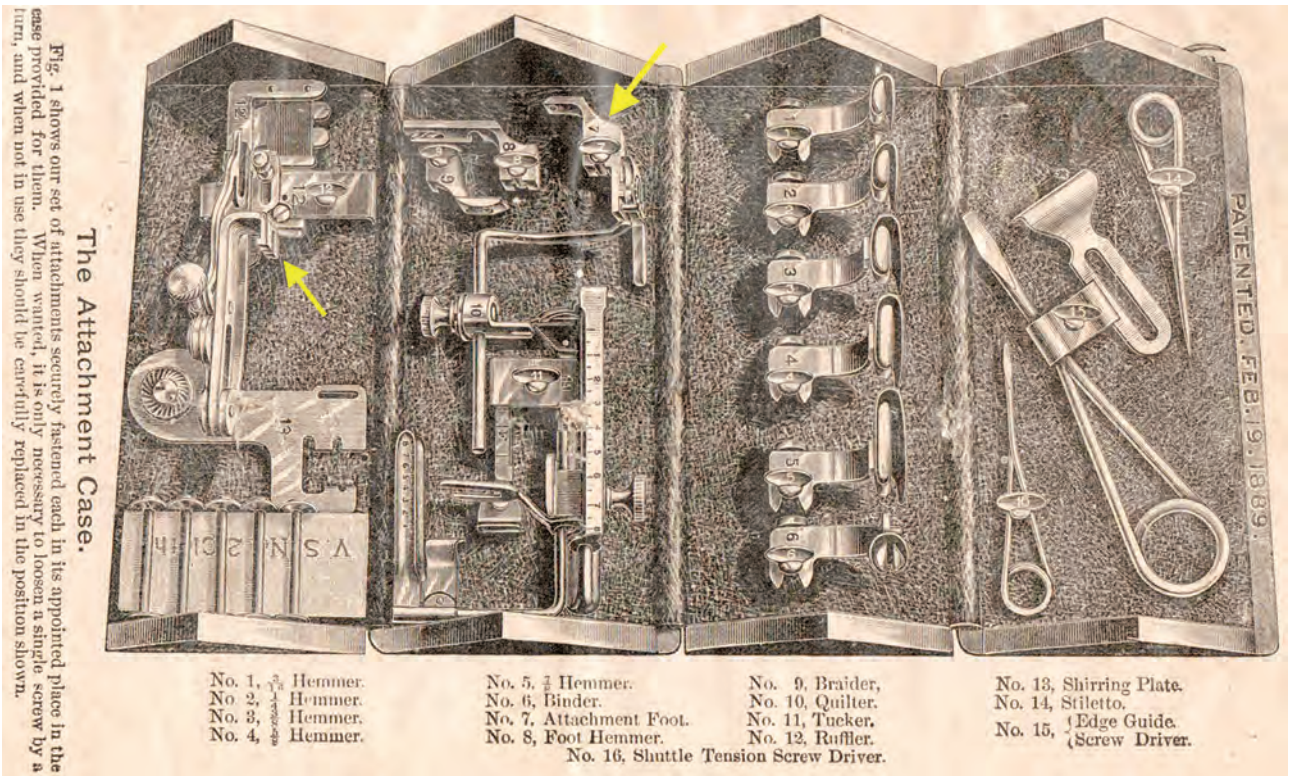

Figure 3

The important feature is the method of attaching the feet:

(a) Style 1 box, Figure 3: The left arrow in Figure 3 (pointing to the ruffler 12) clearly shows that the machine used side-clamping and, although difficult to see, the three feet 7, 8 and 9, with the top arrow pointing to 7, are also side-clamping. However, in the second compartment from the right, the five *hemmers* 1 - 5 and the *binder* 6 have long, curved posts and are back-clamping! (This is easier to understand by comparison with Figure 4 that has the same parts but they are attached differently.)

This is why there is a complex *attachment foot* 7 highlighted by the top arrow. The attachment foot is side-clamped onto the presser-rod, 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 5.[7]

(b) Style 12 box, Figure 4: This uses side-clamping, but again the five 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.

4 Singer, 2020a; Wikipedia, 2020b.
5 Singer, 1901.
6 Singer, 1889.
7 Phillips, 2008.

Figure 4

However, the contents of the different style boxes is not clear, as many images 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 photograph of a "style 14 box" [8] has parts from a style 3 box in a style 12 box.[9]

All 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, but this is freehand stitching is relatively difficult.)

For example, Figure 5 shows the use of a 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.* [10]

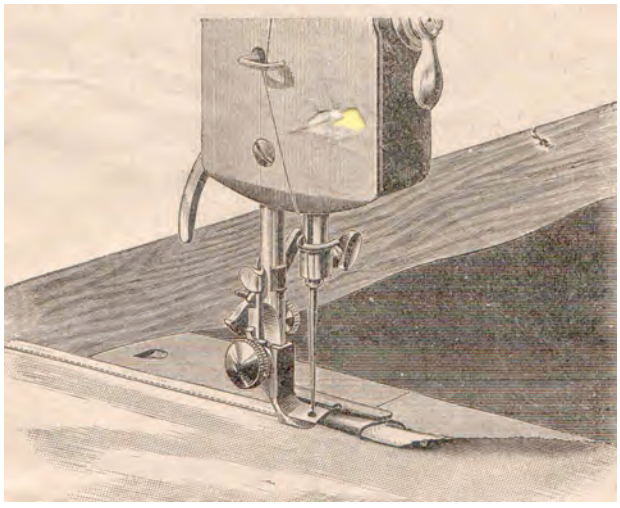

Figure 5

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 very difficult to do free-hand.

8 Wikipedia, 2020a.
9 Singer, 2020a.
10 Singer, 1889, page 15.

Figure 6 shows the same type of hemmer, but with a later method of attachment to another vibrating shuttle machine.[11] This form of attachment would have been included in a style box, but there is no information about it (perhaps it is style 2 as I think it probably comes between the other two methods of attachment). However the hemmer is Singer Part No. 25509 and it is attached by the braiding foot, Singer Part No. 25510.[12]

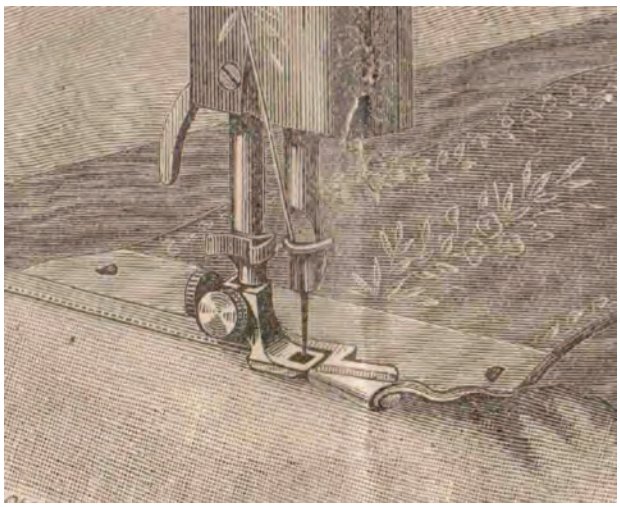

Figure 6

In addition, Figure 7 shows the attachment method used in the style box in Figure 4.

There is no doubt that the presser-foot rod and its side-clamping flat and screw hole were standardised at some time before 1888. But also the distance between the presser-foot rod 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 box was made in 1892 and the style 11 box was made in the early years of the 20th century. However, the attachments fit onto the 1948 Singer 201K, and Figure 7 shows the style 3 box attachment foot and a hemmer fixed to a Singer 222K manufactured in February 1957. That style also fits a Singer Model 27, circa 1900.

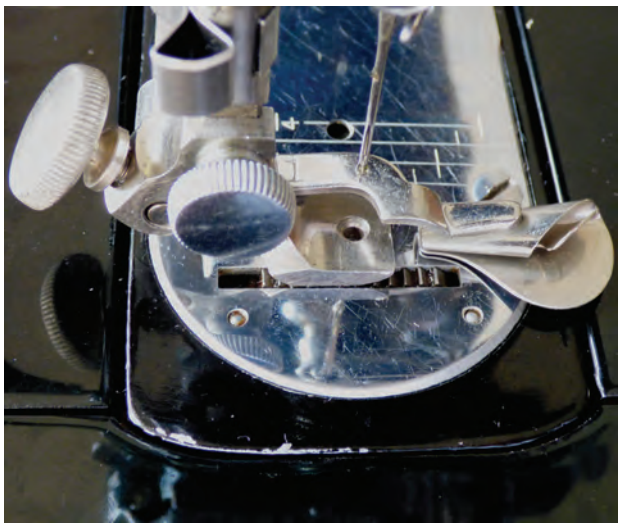

Figure 7

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

When Singer standardised their design is not known, but it was probably some years before the style boxes were produced. Certainly the style 1 box was made to hold an existing collection of attachments, as the style box itself was patented in 1889, 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])

Figure 8

In addition, there are two photographs of two different Singer Model 12 machines that are dated 1871, and they show that it has side-clamping presser-feet with a square presser-foot rod as in Figure 8, reproduced with permission of Wolfegang's Collectibles. Although not certain, later presser-feet

11 Singer, 1891, page 19.
12 Singer, 2020b.
13 Wikipedia, 2020a.
14 Singer, 1891, pages 2-3 and page 13, for example.

would probably fit it, pushing back the date of standardisation, of the presser-foot attachment and the presser-foot rod and needle rod distance, by 14 years.

This standardisation is very important, because the end-user 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 1907 to 1956.[15] Early model 66 machines used back-clamping presser-feet and attachments, rather than the common side clamping used on other models. It is clear that this was a significant blunder, because it was quickly changed to side-clamping on later model 66 machines!

Another, quite early attempt to make interchangeable presser-feet was the 1876 Wheeler & Wilson sewing machine.[16] It had a fixed presser-foot into which inserts could be placed, Figure 9, but these were conveniences to help the user make ordinary straight stitches, and the only "clever" foot was the hemmer, again illustrating the importance of that design.

Figure 9

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 10 (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 5 we can see that the a similar design was used in 1888.

The Singer Model 12 in Figure 8 is different, having a large, cylindrical screw holding the needle, similar to the screw holding the presser-foot. The ruffler in Figure 17 would fit it, but the later zig-zag and buttonhole feet may not.

Figure 10

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 presser-feet.

Some early domestic and some industrial machines used a *vertical feed* or *walking foot*. Instead of feed dogs in the base of the machine, the feed dogs are in the foot and there was a mechanism in the head to provide the up-down, backward-forward motion. However, the common walking feet for domestic sewing machines use the feed dogs in the base of the machine as well as motion of the foot itself. Although used in several situations, a primary purpose of walking feet is when sewing two layers of material together. In that situation, especially if the top layer is smooth, the feed dogs in the base might move the bottom layer but the top layer may be stationary or move a different distance. The purpose of a walking foot is to overcome this problem; as the walking foot moves it shifts the top layer of material along with it.

15 Singer, 2020c.
16 Wheeler & Wilson, 1876.

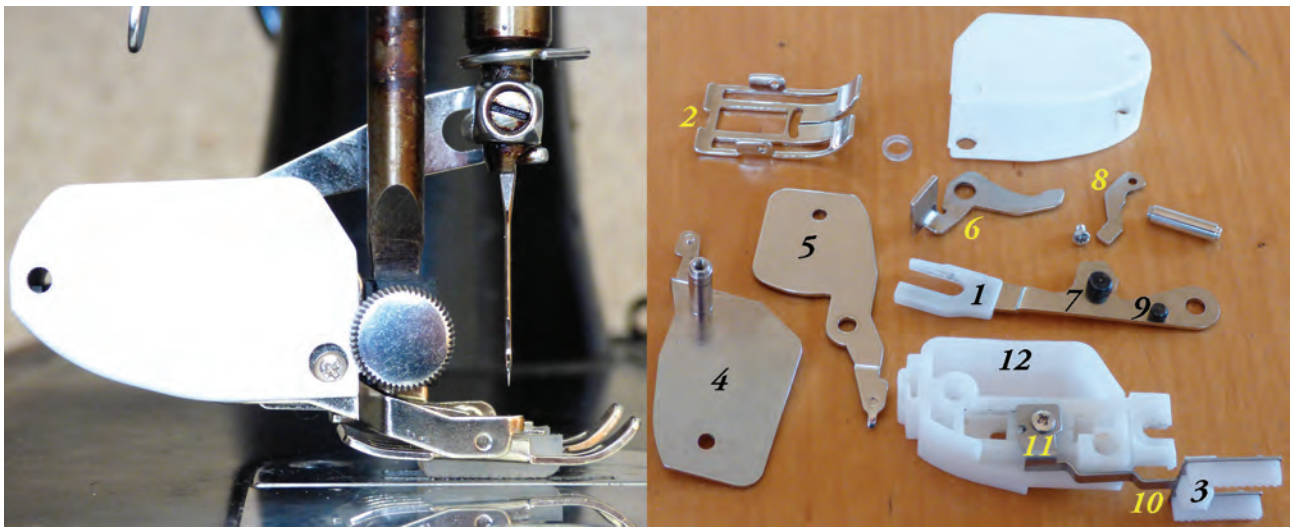

Figure 11

Figure 11 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.

The feed-dogs ***3*** are attached to a metal strip ***10***. It 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 a small spring under the holding screw so that the feed-dogs are continually being pressed up. The foot ***2*** is mounted between the cover plates ***4*** and ***5***.

There are three levers to control the motion of the feed-dogs, Figure 12. 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 presser-foot. 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 11 left. This is possible because the presser-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.

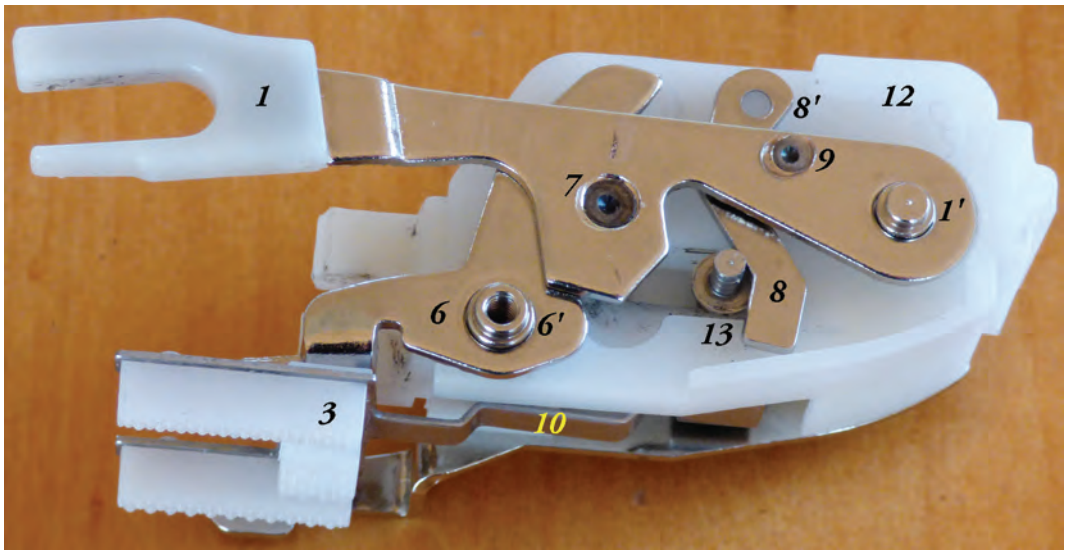

Figure 12

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 presser-foot. 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 to the right.

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 presser-foot ***2*** holding it back.

And when the needle drops the presser-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.

Figure 13 shows a Singer "Penguin" walking foot.[17] It has a similar action to the foot in Figure 11 and the three labels ***1***, ***2*** and ***3*** are the same.

When forming a stitch the foot ***2*** is forced down and holds the material firmly, because the needle arm ***1*** is under the needle clamp, while the "feed-dogs" ***3*** move out but above the material. And when the machine's feed-dogs move the material, the foot ***2*** rises and the "feed-dogs" ***1*** press down on the material and move back in unison with the machine's feed-dogs.

Figure 13

The important difference between these two walking feet is that there are actually no feed-dogs under ***1*** in the Penguin foot and it has a smooth surface, relying on friction to move the top material. This is necessary because, unlike Figure 11 where the feed-dogs are loose and can move an arbitrary amount, the corresponding "feed-dogs" in the Penguin walking foot are moved a fixed distance. But most sewing machines can vary the number of stitches per inch by varying the movement of the machine's feed-dogs and if the Penguin foot had feed-dogs it would force the upper piece of material to move a different distance from the lower piece.

Finally, the Singer Penguin foot is rare and absurdly expensive, about $1,000 if you can get one. Although better made (even so, it has a fault in the design[18]) a large number of the walking feet in Figure 11, enough to last several lifetimes, can be bought for the same outlay. We will never have one!

Using the Motion of the Needle: The Tuck Marker

Another foot that uses the motion of the needle is the tuck marker that is included in the early style boxes, and is only discussed here for that reason. Although appearing to be complicated, Figure 14, it is actually quite simple.

17 Singer, 1953.
18 Featherweight Shop, 2020.

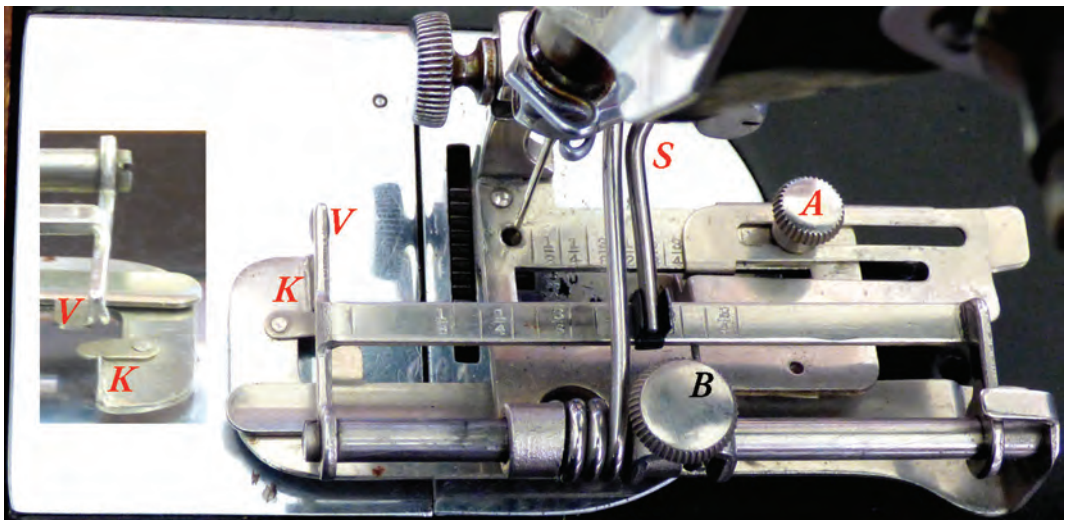

Figure 14

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

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 blunt 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. Only the downward motion of the needle is used.

Figure 15 is a sample piece with three tucks and, at the top, the mark in the material for the next tuck.

Figure 15

Using the Motion of the Needle: The Ruffler Foot

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

Figures 16 and 17 show a Singer 26156 *ruffler foot* circa 1901 and what it produces. (It cost $0.65 then, about $150.00 now.)

The ruffler is attached to the presser-foot rod 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 ***6;*** the upper blade attached to the arm ***D*** is shorter and has a serrated edge to grip the material.

When the needle rises after forming a stitch, the lever ***E***, also pivoted at ***1***, is rotated clockwise by the stop ***Sr*** and it moves the lever ***D***, pivoted at ***2***, and so moves the upper blade to the left; it can only move horizontally to the left because of the three blades ***7*** attaching it to the base ***8*** of the presser-foot. The upper blade is serrated and when it moves forward, to the left, it folds the material before the next stitch is made.

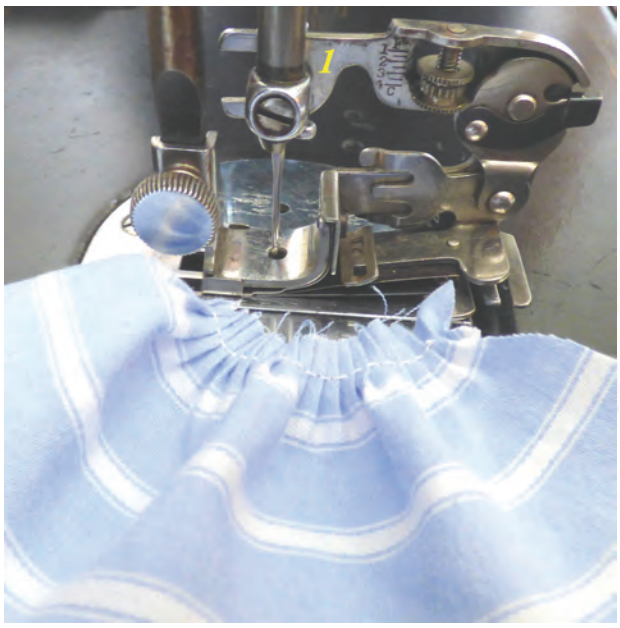

Figure 16

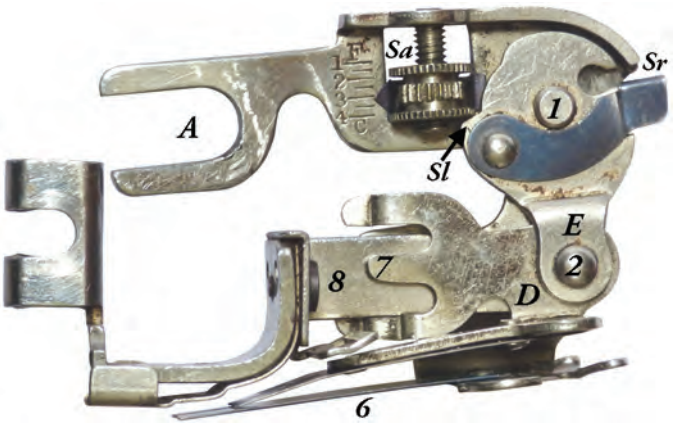

Figure 17

This movement clockwise cannot be varied. However, when the needle arm ***A*** drops, the thumb-nut ***Sa*** butts against the stop ***Sl***, which is part of the lever ***E***, and rotates ***E*** anti-clockwise, moving the lever ***D*** 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 can be used with that machine.

Replacing the Feed-dogs: The Zig-Zag Foot

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 10. 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* presser-feet 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.

(b) Feed-dogs in the presser-foot to move the material; that is, a *walking foot*.

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

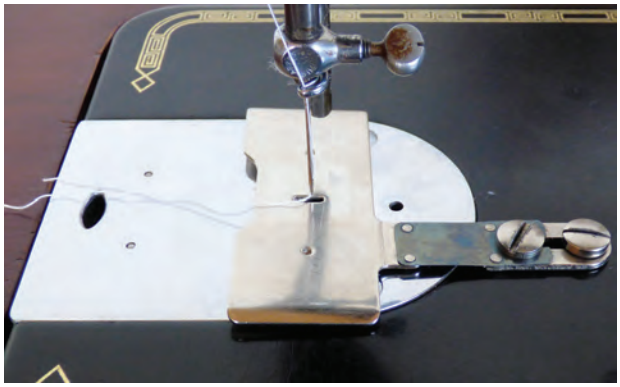

Figure 18

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

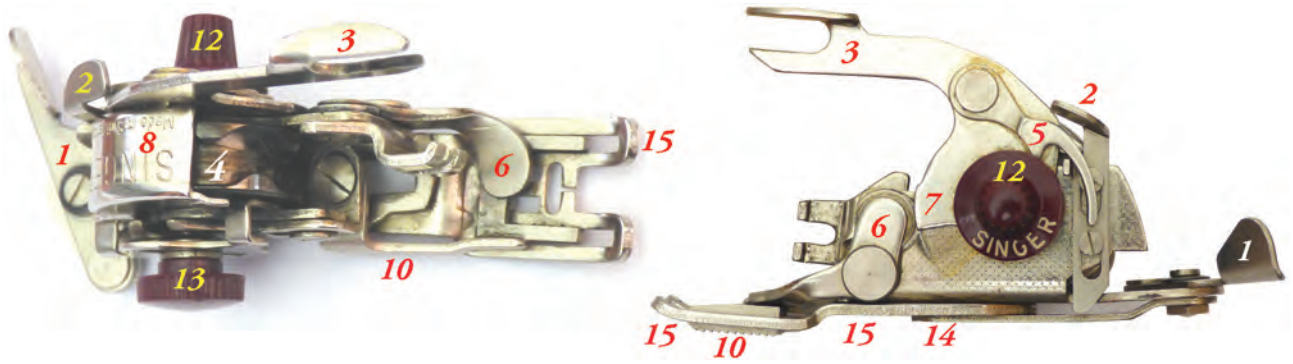

Figure 19

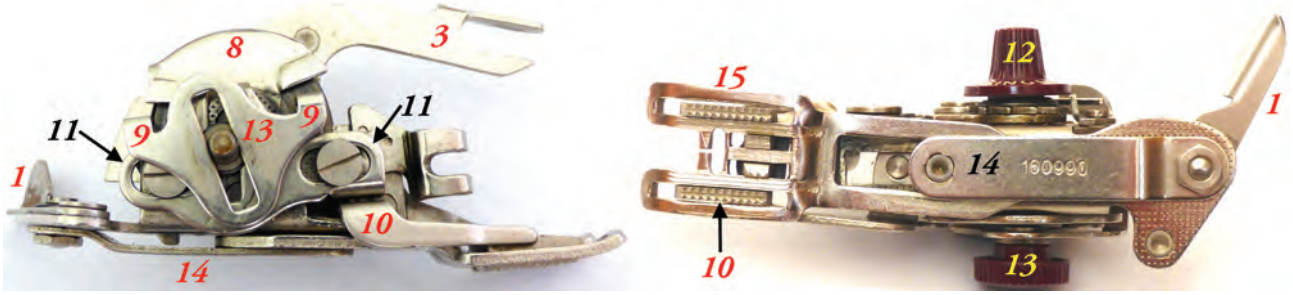

Figure 20

This presser-foot 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. It is controlled by the rotation of the main cam ***4*** (Figure 19 left) that moves the feet ***15*** and the material sideways, and the lever ***1*** adjusts that distance and so adjusts the width of the zig-zags.

At every stitch, the pawl ***5***, Figure 19 right, is moved by the motion of the needle and it 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. The main cam moves the feet sideways. The feed-dogs ***10*** are pivoted and, because they fit in gaps in the feet, they and the material also move sideways to form the zig-zag pattern.

This foot 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 feet ***15***, Figures 20 right and 21, are at the end of a lever 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 feet move sideways.

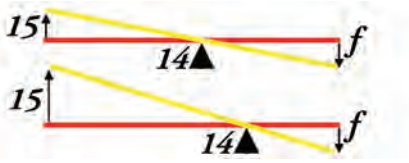

Figure 21

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 are loose, but every time the needle 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 presser-foot discussed earlier, the feed-dogs cannot move down, because they are pressed against the cover plate, and the pad ***6*** raises the whole presser-foot up so that the material is only held in place by the feed-dogs and the feet ***15*** are 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 ***10*** 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.

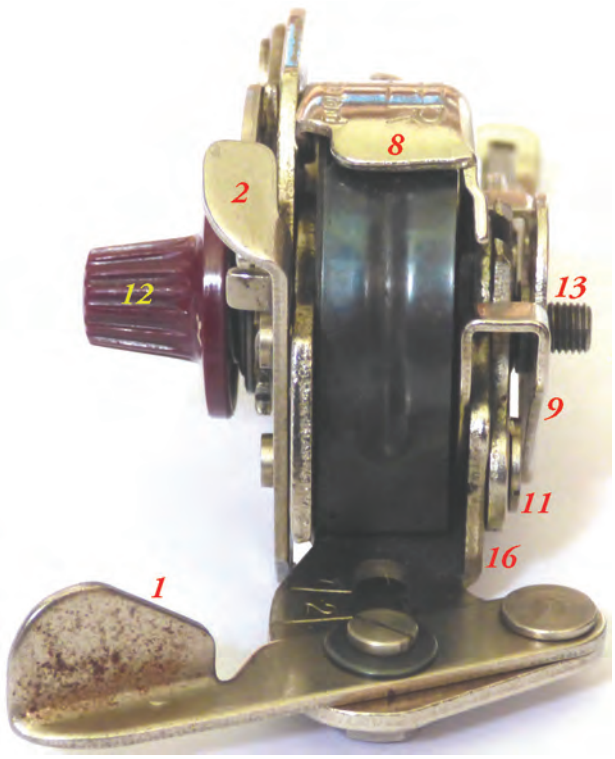

Figure 22

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 produces 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.

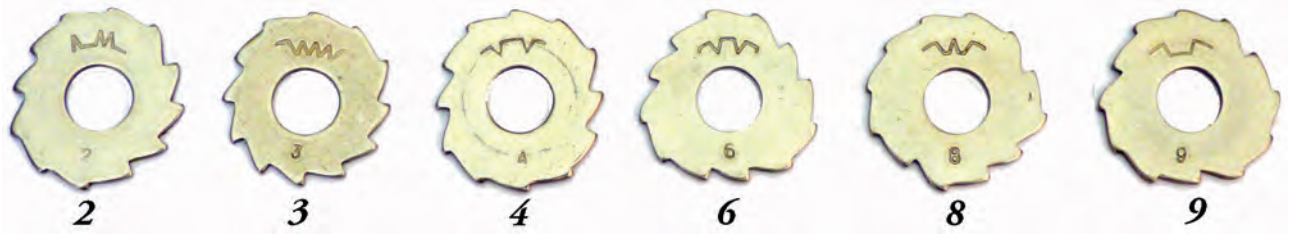

Figure 23

Figure 24

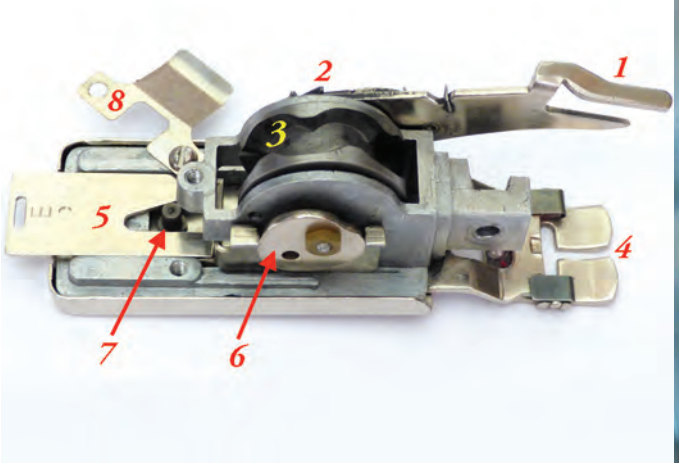

Figure 25

Figure 26

Figure 25 is a later Asian YS-7 zig-zag presser-foot with its cover removed to show the main cam ***3***. It also 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 26, that go into the back of the foot at ***5***; plate ***E*** is installed in Figure 25, 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 foot, 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 width can be changed.

These pattern plates fit into a carrier that is moved forward and backward by the heart cam ***6***.

This zig-zag presser-foot 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. (In contrast, the Singer zig-zag presser-foot has pointed feed-dog teeth that can move the material in all directions.)

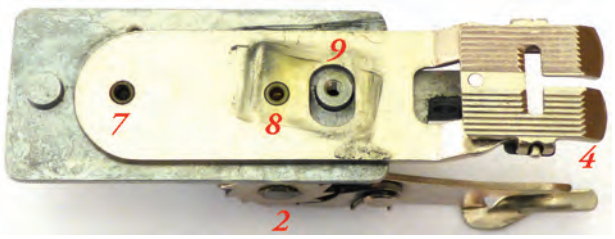

Figure 27

The foot ***4*** is loose, free to move sideways but limited by a slot ***9*** in the base of the presser-foot, and so it is only held in position by the material and can rotate around its center ***8***, 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 ***8***, the main cam moves the presser-foot sideways, but this movement is limited by the finger *7* that fits into the slot of the pattern plate. Because the presser-foot is loose some of the sideways movement caused by the main cam then forces the front of the presser-foot sideways to make a zig-zag.

When there is no pattern plate the finger *7* is completely free to move and the presser-foot oscillates without moving the material.

Replacing the Feed-dogs: The Buttonhole Foot

The buttonhole presser-foot is a more sophisticated zig-zag foot. This presser-foot is also a walking foot with its own feed-dogs, like the Singer zig-zag presser-foot, and a cover-plate is needed to stop the sewing machine's feed-dogs being active.

Figure 28 shows the left side of the presser-foot; it is complete except that its cover has been 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 presser-foot before starting to sew.

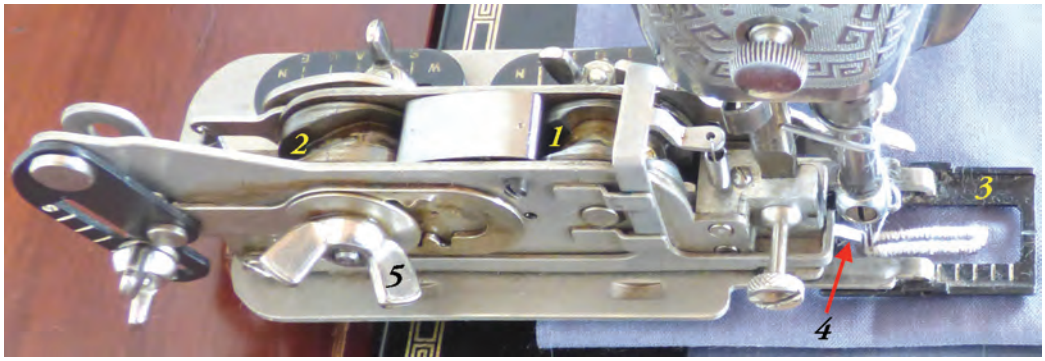

Figure 28

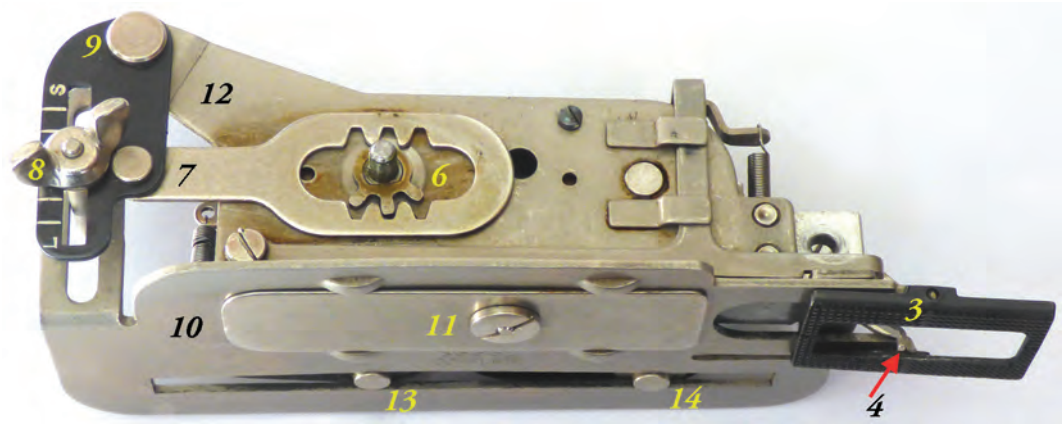

Figure 29

Figure 29 shows the left side of the presser-foot with the wing-nut ***5*** and the covering disk removed.

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.

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.

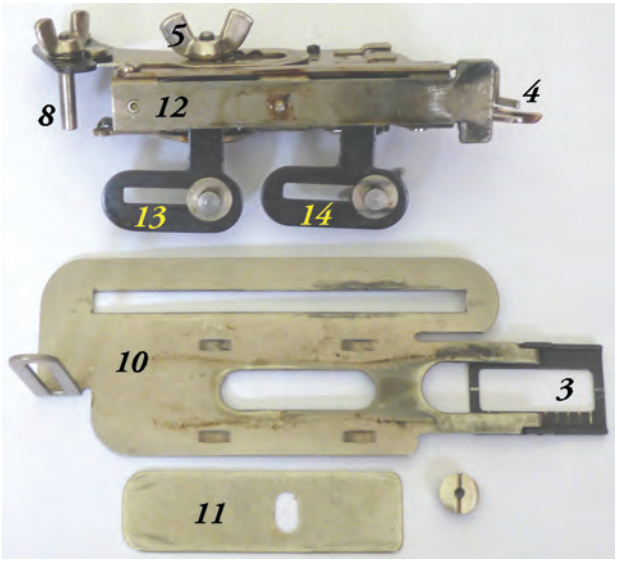

Figure 30

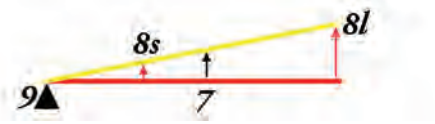

Figure 31