

**Sept. 11, 1956**

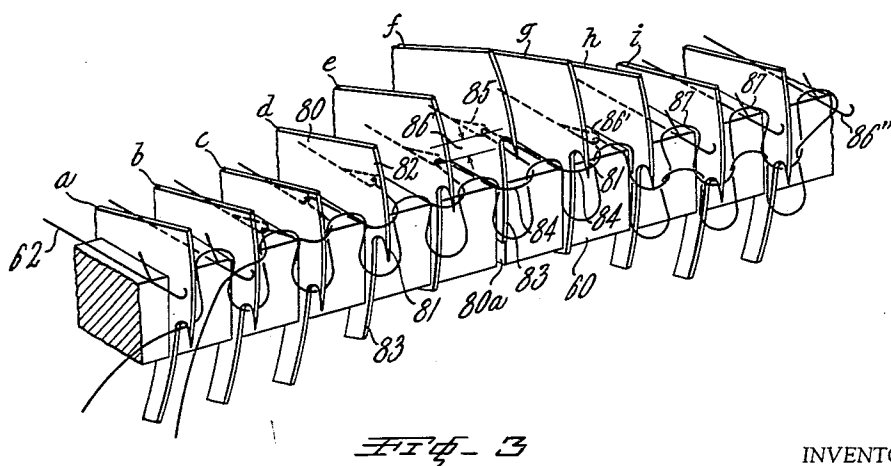
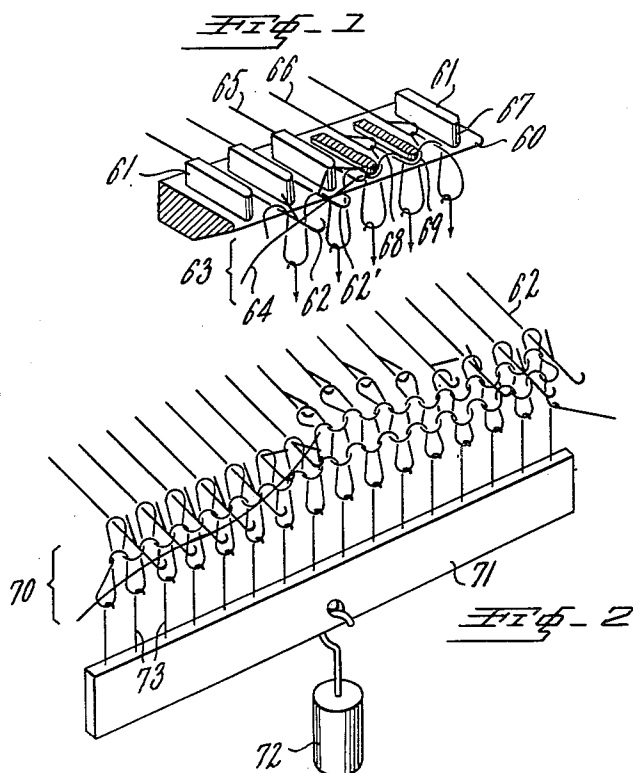
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**2,762,213**

# HAND KNITTING APPLIANCE

Filed Feb. 18, 1953

5 Sheets-Sheet 1



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Sept. 11, 1956

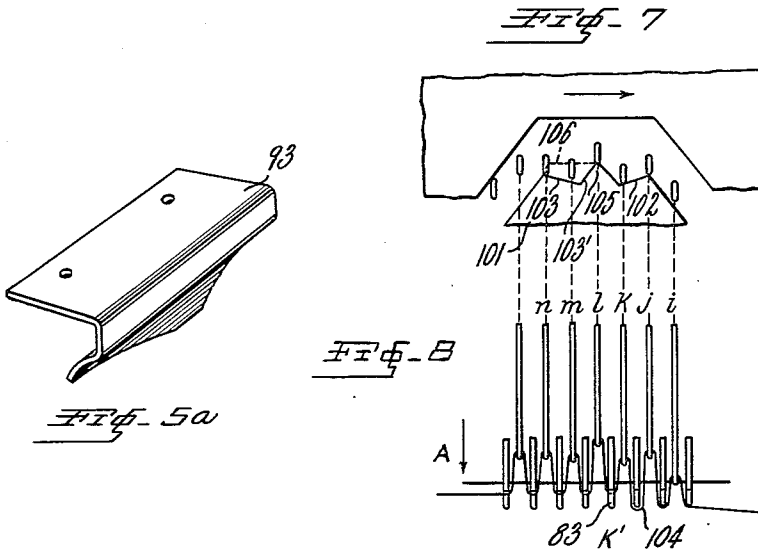
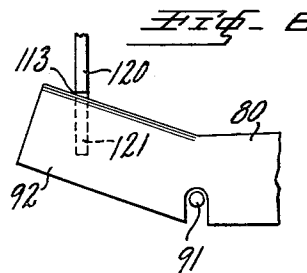
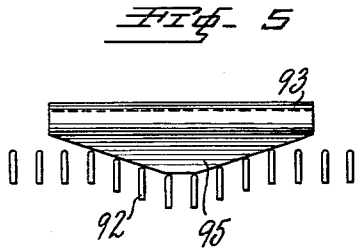
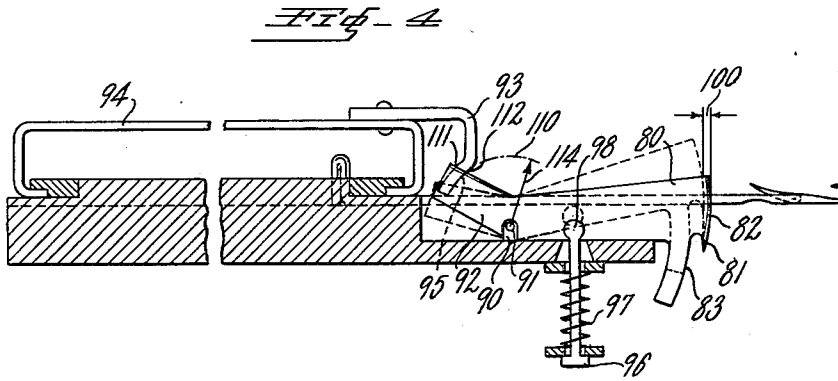
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HAND KNITTING APPLIANCE

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5 Sheets-Sheet 2



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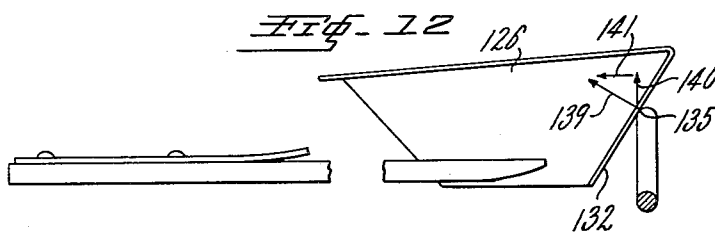
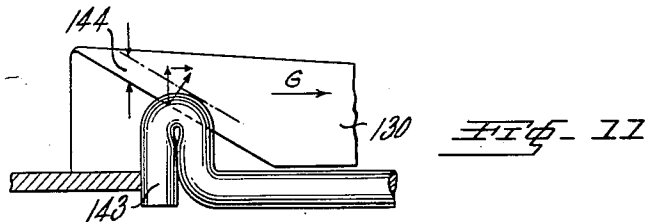
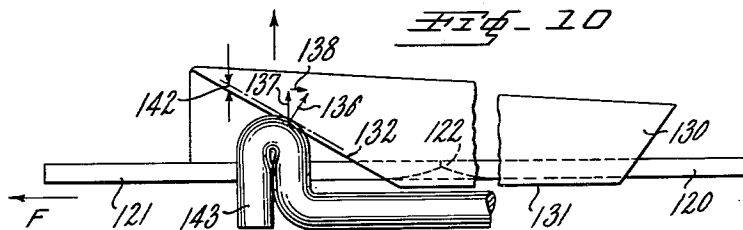
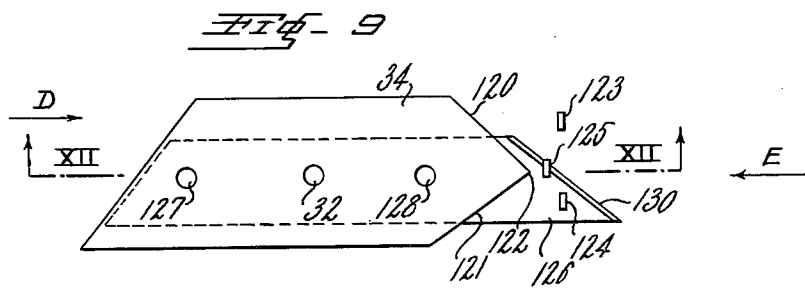
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HAND KNITTING APPLIANCE

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5 Sheets-Sheet 3



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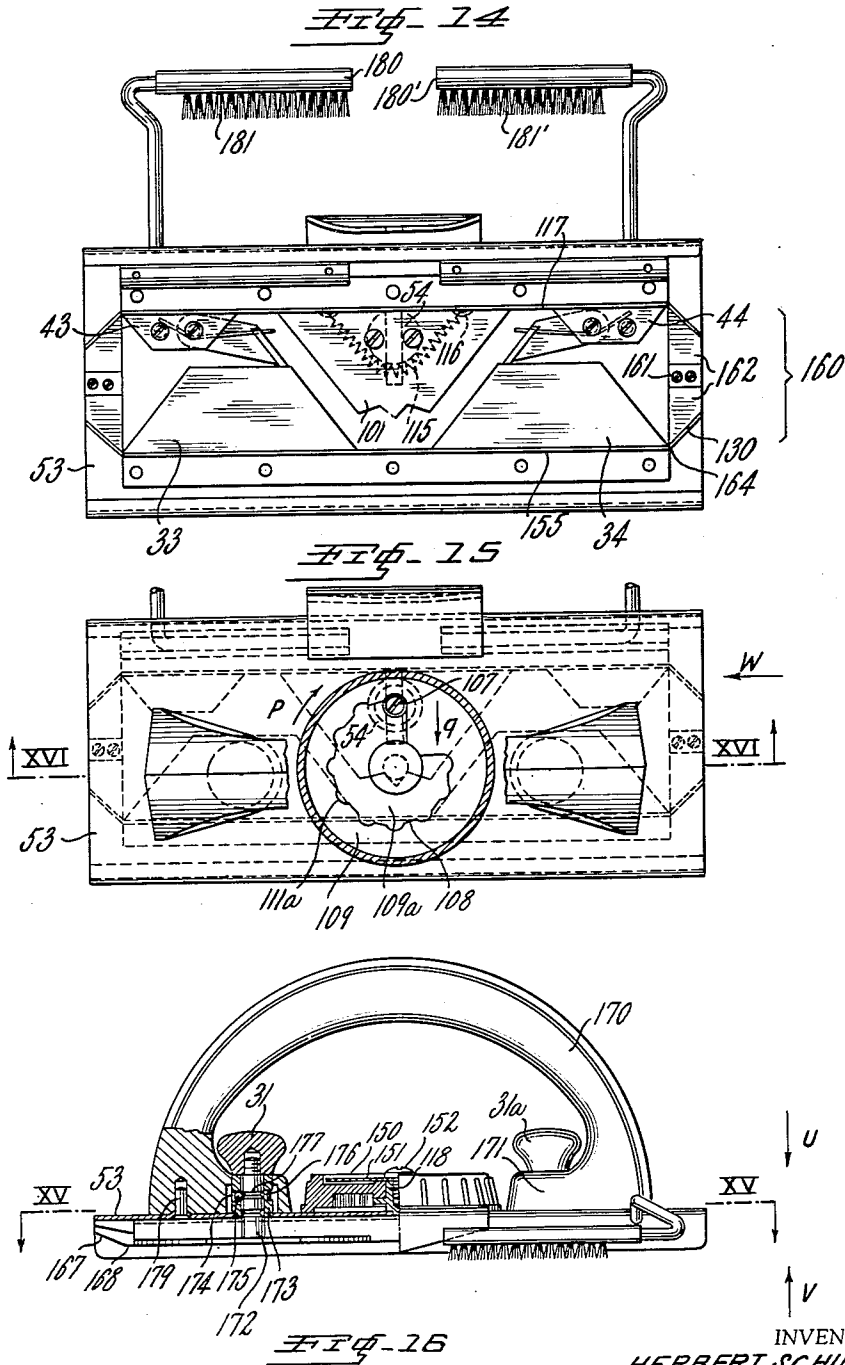
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5 Sheets-Sheet 4



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2,762,213

HAND KNITTING APPLIANCE

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5 Sheets-Sheet 5

FIG. 17

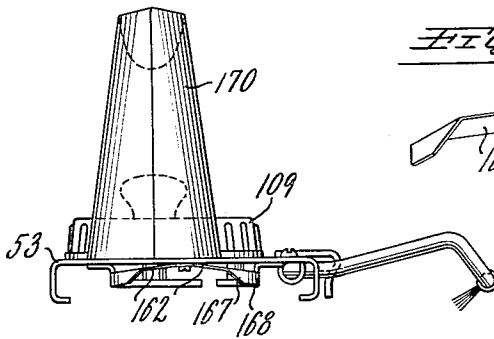


FIG. 18

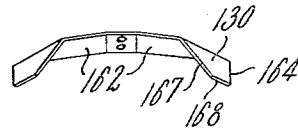


FIG. 19

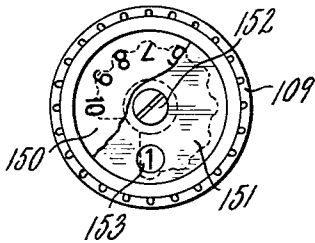


FIG. 20

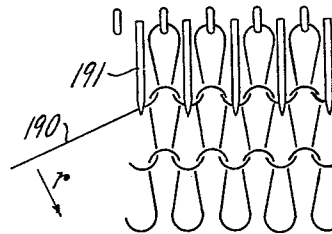


FIG. 21

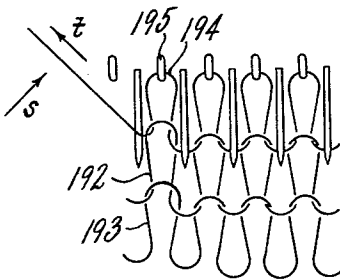
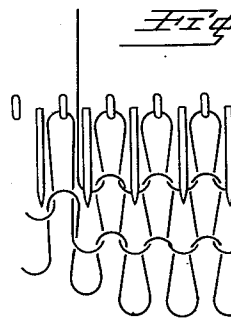


FIG. 22



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1

2,762,213

## HAND KNITTING APPLIANCE

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Application February 18, 1953, Serial No. 337,590

Claims priority, application Germany February 18, 1952

7 Claims. (Cl. 66—106)

For the production of looped fabric on a hand knitting appliance it has already been proposed to cause the latch needles which are arranged in a needle bed to perform in connection with reciprocal motions of a lock out of a thread inserting position, effected by hand, each time a withdrawal motion behind the full play line of the knocking over bits and thereupon an oppositely directed ejection motion extending beyond the thread inserting position, for enabling the freshly formed loops to slide backwards over the free ends of the opened latches.

It was further proposed to impart to the needles an additional rearward or withdrawal movement directed inwardly of the needle bed to such an extent that the open latches at the free ends of the needles would be retracted into the needle guide grooves, i. e., behind the play line of the knocking over bits which are constituted by the front edges of abutments provided on the needle bed intermediate the needle guide grooves. In accordance with this proposal, after the end of each lock motion transversely across the needle bed and longitudinally of the row of needles and prior to the start of the next lock motion in the opposite direction, the thread is placed by hand and under tension over the shafts of the needles from above the latter and close to the needle hooks provided at the ends of the needles. Thereafter, the lock is guided over the entire needle bed and thus a row of loops is formed.

In order to enable this to be carried out, there are provided on the lock a central wing cam, on each side of the latter a disengageable needle lifter, above each of these an auxiliary wing cam and at the place of transition between each needle lifter and the appropriate auxiliary wing cam a pawl with inclined surfaces, such that, with the needle lifter in the operative position, the needle heels will in successive lock motions alternately slide over one of the pawls, the needles being pushed out of the needle bed, and pass through below the other pawl, raising the latter pawl.

It has hitherto been necessary to employ a tension-applying comb consisting of a weight-loaded bar provided with a plurality of hooks arranged in a row.

This straight hand knitting apparatus has the disadvantage, however, that the tension-applying comb with its attachable weight not only constitutes a part of the whole appliance, which has to be separately stored, may be easily mislaid and is thus frequently not available in case of need, but also makes manipulation more difficult during the knitting operation, as it hangs down in the way from the knitted fabric which is being formed.

The invention consists more particularly in that in place of the tension-applying comb there are provided at the same places in the needle bed so-called sinkers which are so arranged as to be movable in slots of the needle bed and are offset in a step-like fashion at the forward edge (knocking over edge) in such a manner that the lower step part is bent backward or recedes, so that, during upward and downward movement of the sinker

2

the formed loops are forced downwards by said lower step part.

Thus, by these sinkers not only is the function of the knocking over bits, namely the knocking over of the course of loops, fulfilled, but in addition the function of the tension-applying comb, namely the downward movement of the just formed course of loops.

In order to adapt the lock to the particular features of the novel loop formation, it is of advantage to provide at the flat point of the wing cam a pointed part extending beyond it, which gives the needles an additional backward pulling motion.

As the needles, in so far as they are not caught by the parts of the lock, are supported so as to be freely movable, it may easily occur in the case of inexpert handling of the straight hand knitting appliance that individual needles may be in any intermediate position and block the lock.

In order to avoid this disadvantage, according to the invention the outwardly facing edges of both needle lifters may be provided with inclined surfaces, against which the heels of needles lying in an incorrect position will strike and, sliding during the further movement of the lock along these inclined surfaces, be thrown upwards or downwards, so that the free motion of the lock will not be hindered. At the same time it is of advantage to let these inclined surfaces which act as a deflecting edge taper to a point, in order that in every position a deflection of the heels is possible.

In specially unfavorable cases it may occur, that the point of the particular needle lifter will strike against the heel and thus not deflect the needle. If in such a case an attempt be nevertheless made to move the lock in the particular direction, damage to the needle and the needle bed may result.

In order to avoid this disadvantage, according to the invention, there is provided in each case at one of the outwardly directed edges of each needle lifter a deflecting element which consists of a movable construction element having an inclined deflecting edge and the function of which is, that the heel either, lifting the deflecting element, passes through under it and thus arrives at one side of the outer needle lifter point, or, sliding along the inclined surface of this deflecting element, is guided to the other side of the needle lifter point. In this way provision is made, that the heel will never in the most unfavorable positions, come against the outer point of the needle lifter but will each time take up a position to the right or left of this point.

In a special modification of the idea underlying the invention the deflecting element consists of a sheet metal strip which is flat and disposed parallel to the longitudinal direction of the needle lifter and the outwardly projecting edge of which is bent over at an inclination and angle downwards in such a manner that an outer inclined deflecting surface is formed, the forward edge of which is also directed at an inclination downwards and towards the point of the needle lifter. This sheet metal deflector may according to one constructional form be connected at the inner end by a hinge with the needle lifter, so that, on a needle heel striking owing to the motion of the lock, the heel will according to the momentary position strike against the outer angled inclined surface and slide along it, resulting in the heel being deflected above the outer point of the needle lifter. In other chance positions of the needle heel it will strike with an outer edge against the forward obliquely extending edge of the deflector in such a manner that the latter will be raised and the heel passing through below the deflector and coming against the lower outer inclined surface of the needle lifter can slide along the latter. Through this arrangement the needle

heel will with certainty be prevented from striking against the outer point of the needle lifter, whereby the lock would be blocked.

Instead of the hinge-like attachment of the deflector a fixed arrangement is also possible at the inner end by riveting or welding to the needle lifter. For this arrangement the deflector will have to be made of sufficiently thin and flexible sheet material, so that, on the needle heel impinging on the inclined surfaces, either a lateral sliding off the angularly bent over inclined surface or a slipping through below the forward inclined edge through a slight upward springing of the deflector will take place.

Further details of the invention shall now be described with reference to constructional examples illustrated in the accompanying drawings, in which:

Figure 1 shows a perspective view of the forward edge of the needle bed with the knocking over bits according to an older suggestion;

Figure 2 shows in diagrammatic and also perspective representation a front view of the row of needles with several formed rows of loops and hooked-on stripping comb according to the older proposal;

Figure 3 shown in diagrammatic and perspective representation a front view of the needle bed according to the invention with the upwardly and downwardly moved sinkers;

Figure 4 is a cross-section through the needle bed and the lock;

Figure 5 shows a front view of the appliance according to Figure 4, in which only the position of the sinkers and the cam piece is shown;

Figure 5a is a perspective view of a detail of the appliance shown in Figure 4;

Figure 6 shows a partial side view of a sinker and the lower part of a cam piece, the lower part of which is not curved in a circular arc, but is made straight;

Figure 7 shows a partial view from below of the lock, in which mainly the lower part of the wing cam is shown;

Figure 8 shows a diagrammatic view from above of the forward part of the needle bed with the individual positions of the needles and the sinkers in diagrammatic representation;

Figure 9 shows a view from below of a constructional example of a needle lifter with a riveted-on deflecting element;

Figure 10 shows a partial view of the needle lifter according to Figure 9 looking in the direction of the arrow E with a partial view of a needle in a position, in which the deflecting element is raised by the needle heel;

Figure 11 shows a similar view, but with another position of the needle heel with respect to the deflecting element, in which the needle heel is deflected at the forward inclined surface to the right;

Figure 12 is an elevation of a needle lifter in section along line XII—XII of Figure 9;

Figure 13 is a similar section through a needle lifter with a hinged-on deflecting element;

Figure 14 shows a view from below of the lock viewed in the direction of the arrow V of Figure 16;

Figure 15 shows a view from above of the lock viewed in the direction of the arrow U of Figure 16, in which for the sake of clearness parts of the handle are omitted and the adjusting disc is in section along line XV—XV of Figure 16;

Figure 16 is an elevation and partial longitudinal section on line XVI—XVI of Figure 15;

Figure 17 shows a side view of the lock seen in the direction of the arrow W of Figure 15;

Figure 18 is a perspective representation of the double deflector for the needle heels;

Figure 19 shows a view from above of the adjusting disc seen in the direction of the arrow U in Figure 16, in which view the cover disc is shown as partly broken away; and

Figures 20 to 22 are views of the knitted fabric shown

as suspended in the needle heads by means of the uppermost row of loops and held by the sinkers in the various stages of a separating operation.

In the appliance of Fig. 1 there are arranged at the forward edge 60 of the needle bed knocking over bits 61, between which the needles 62 move. From this Figure 1 it will be seen how the first course 63 hangs to the left over the two needles 62, 62'. The figure also shows how the second course is formed by means of the piece of thread 64. The two needles 65, 66 lying to the right are retracted and it is shown how the loop formation of the second course is produced through the thread placing itself not only round the hooks of the needles, but also round the forward edge 67 of the knocking over bits.

In this mode of producing the knitted fabric it is necessary to load or tension the fabric 70 (Figure 2) with a weight 72. In order that this weight may distribute itself uniformly over the fabric 70, a so-called tensioning comb 71 is provided, to which the weight 72 is attached. This tensioning comb is provided with a number of tensioning hooks 73 which are arranged in the same spacing on the tensioning comb as that of the needles 62 in the needle bed.

The pull on the fabric exerted by the weight has the purpose of pulling after the forming of each course the last formed course off the knocking over bits, namely downwards over the front edge 60 (Figure 3) of the needle bed, so that the forwardly thrusting needles will find a free path forward and will not be disturbed by the upper loops 68 of the last course but one. This is shown particularly clearly in Figure 1. The needles 65, 66 would in their forward thrust strike against these upper loop parts 68, if the last course but one, 63, and with it these upper loop parts 68 together with the forward loop parts 69 of the last formed course were not drawn downwards by the downwardly exerted pull of the weight.

In contradistinction to the aforesaid construction the weight with the set up comb is entirely avoided according to the present invention. For this purpose, in accordance with the invention, the knocking over bits 61 are replaced, as shown in Figure 3, by sinkers 80 which take the place of the knock over bits and are arranged for movement on the needle bed, where in the constructional form hitherto usual the knock over bits are disposed. The difference consists substantially in that, these sinkers are not stationary like the knock over bits 61, but are arranged so as to swing in corresponding slot guides 80a in the needle bed. In addition there are provided on the knock over edges 82, 83 of these sinkers claws 81 in the form of downwardly directed pointed hooks which divide the knock over edges of the sinkers into an upper knock over edge portion 82 and a lower knock over edge portion 83 offset from the upper portion.

How the loop formation and the setting up is performed by means of the arrangement provided with such sinkers 80 will be seen by referring to Figure 3 showing the working principle. According to the present invention the forming of the loops takes place during the backward movement of the needles 62, through the thread first laying itself round the upper edges 82 of the sinkers 80. In the positions a to c the forming of the loops is exactly the same as with the known arrangements with knocking over bits as shown in Figure 1. The difference first occurs in the position d, where the respective sinker is swung upwards, until the claw or hook 81 has left the last formed loop 84 (position f). Between this loop 84 and the lower knocking over edge 83 a free space will thus have been formed. This space is closed, as the forward part 84 of the loop is drawn towards the lower knocking over edge 83, through the hook 85 of the needle being drawn back still further by the distance 86. How this takes place will be described in detail below, when dealing with the lock. In the position g the sinker will again have moved slightly downwards, while the needle will at the same time assume the position 86'. The claw

81 of the sinker has in the position *g* just hooked itself over the forward part 84 of the formed loop and, during its continued downward movement as far as the position *i*, moves the last formed loop downwards beyond the forward edge 60 of the needle bed. The same result is thereby obtained as was hitherto brought about by the weight, that is to say the last course but one of the knitted fabric is not drawn downwards as in the known arrangements, but rather forced downwards, so that the parts 87 of the last formed loops are drawn tightly over the needle shanks, whereby on the needles being thrust further forward, into the position 86'', the latches of the needles will be thrown backwards with certainty through the loops sliding over them.

It will thus be seen that the claws 81 in this constructional form perform the function of the above mentioned set up comb with its hooks and the tensioning weight, namely, that they move the knitted fabric downwards.

The employment of the sinkers in place of the set up comb with its weight has on the one hand the advantage that the whole appliance becomes much more easy to handle. There are no parts to be stored and manipulated separate from the appliance, such as the set up comb with its weight. The sinkers replacing the set up comb in its function are on the contrary fixed to the appliance. Moreover, they do not, like the set up comb with its weights, constitute a bulky downwardly projected part, but take up hardly more space than the hitherto usual knocking over bits between the needles in the needle bed. The appliance also need not be fixed to a straight table edge or the like. It is possible to work with the appliance in any position and even to place it on the lap. In this the appliance differs still more from a knitting machine and assumes a still more pronounced character of a hand knitting appliance.

A further still more important advantage of this improvement consists in that the knitted fabric is given during the knitting the form it will later retain, as no weights whatever are employed, which would tend to stretch the fabric and therefore pull it out of shape. Hitherto, in order to produce articles of clothing to correct measurements, it was necessary to make a knitted sample, so as to obtain a picture of the true dimension, to count up the number of courses of this knitted sample, and then, while knitting, make sure by renewed counting that the knitted fabric will be given the same number of courses. According to the new proposal this counting is no longer necessary, as no distortion takes place. All that is required is to check during knitting the required measurements with a rule.

Furthermore, it is not absolutely necessary to make the needle lifters capable of being put out of operation. According to what has so far been said, first of all a course was formed through the thread being laid by means of the retreating needle hooks round the knocking over bits of the needle bed and the comb hooks of the tensioning comb. For this reason it was necessary first of all to put the needle lifters out of operation and, after the formation of the first course of loops, to put them into operation again one after the other during the next following lock movements. According to the present invention the needle lifters may be rigidly fixed to the lock as the function of the tensioning comb is here taken over from the start by the movable sinkers, so that during the first lock movements the first course of loops is completely formed.

Finally there is the further advantage that, even when not using first quality yarn, the fabric will show high regularity and evenness of the loops. This may be accounted for by the circumstance that following the complete first loop formation the tightening of thread takes place through a short backward movement of the needle, as was described in phase *f* in Figure 3. Through this

tightening small irregularities of the tension of the thread will be corrected.

Figure 4 shows a side view of one of the sinkers and a cross-section through the needle bed and the lock guiding arrangement. The sinker 80 has in the rear portion a notch 90 which is open at the bottom and acts as a pivotal support. With this notch 90 the sinker engages over a wire 91 which is supported in the longitudinal direction of the needle bed and acts as the pivotal point for the sinker. Towards the rear the sinker 80 is provided with a guiding part 92. Into engagement with this guiding part can be brought a cam piece 93 (see also Figure 5a) which is fixed to the lock plate 94.

The lower actually effective part 95 of the cam piece has a curvature constituting a portion of a circular arc 110 traced substantially with a radius 114 about the pivotal point 91 as centre. Through this arrangement it becomes possible, that in all positions of the sinker there will be linear contact from the point 111 to the point 112 (Figure 4) and not only point contact 113 (Figure 6) between the sinker and the cam piece, which would be the case, if as in Figure 6 the cam piece 120 in its lower part 121 were not curved to a circular arc, but were made straight. If linear contact were sought in this case as well, the contact surface at the cam piece would have to be shaped as a complicated undulating surface, which would present technical difficulties of manufacture. Linear contact is important, however, so as to avoid overloading and consequent rapid wear.

For moving the sinker each time back into the normal position and giving it the necessary pressure for tensioning the loops, each sinker is connected by way of a tie-rod 96 with a compression spring 97. For simplifying the assemblage of the parts, the tie-rod engages with a circular widening 98 in a corresponding recess in the under side of the sinker.

The front edge 82 of the sinker 80 is so curved and so displaced upwards relatively to the centre of gravity 91 (Figure 4), that, on being rocked out of the bottom position (full lines) into the upper position (dotted lines), the edge 82 will in the middle part recede by about the amount 100. This has the advantage of a decrease in tension of the loops during the upward swing of the sinker.

A further decrease in tension is produced through the needles which after being drawn into their momentarily lowest position, are slightly loosened.

This is brought about by the needle sinker or actuator 101 (Figure 7) having two slightly inclined surfaces 102, 103. On following the process of loop formation in Figure 8 from right to left, it will be seen, that from the position *i* to *k* the needles slide somewhat forwards in the direction of the arrow A, so that the loop in the position 104 loosens. In the position *k'* the thread has moved under the claw 81 of the sinker. By the triangular projection 105 on the needle sinker the needle is drawn back sharply (position 1, Figure 8), so that the thread is drawn close to the lower edge 83 of the sinker (cf. also position *f* of Figure 3). In itself the needle sinker 101 might from there onward follow a straight line, as indicated by the dotted line 106, but this is inadmissible for the reason, that, during the motion of the lock in the opposite direction, the needle has to perform the same motions as on the right-hand side of the sinker. For this reason the needle sinker is made symmetrical, that is it also has inclined edges 103, 103' to the left. Starting from the position *l* to the position *n* the needles do not move along the dotted line 106, but follow the upper edge 103', 103 of the needle sinker, which is due to the circumstance, that the thread tension draws the needles against this edge in the direction of the arrow A. This tension is imparted to the thread by way of the preceding loops by the downwardly moving sinkers.

To sum up it can be stated that the triangular projection 105 in the middle of the upper edge of the needle



sinker has the object of drawing the front part of the loop closely against the lower edge of the sinker, in order that on the sinker performing the next downward motion, the claw 81 of the sinker will with certainty catch this loop so as to force it downwards.

According to the constructional form shown in Figure 9 the right-hand needle lifter 34 is provided with the two outer inclined flanks 120, 121, which terminate in a point 122. When the needle heels are in the positions 123 above the point 122 or 124 below the point 122, they will during movement of the lock in the direction of the arrow D, strike against the outer inclined surfaces 120 or 121 and can be deflected by them upwards or downwards.

Only in some few particularly unfavorable positions will the needle heels strike against the point 122, as indicated by the position 125. In this position they cannot slide off so that there is the danger of damage.

In order to eliminate these unfavorable cases, there is riveted to the needle lifter the deflecting member 126 by the rivets 127 and 32. Since as a rule there are provided on the needle lifter an actuating pin 32 for displacing the needle lifter and two guiding pins 127, 128, the pin 127 and the actuating pin 32 may serve the purpose of fixing rivets for the deflecting element 126. For the guiding pin 128 a corresponding recess is provided. The forward edge 130 of the deflecting element 126 is bent away at a right angle and extends above the inclined surface 120. In addition, this right angled bend is placed at an inclination in such a manner as to run about parallel to the inclined edge 120 of the needle lifter. Whilst the lower edge 131 (Figure 10) of the right angled bend 130 runs about parallel to the surface of the needle lifter, the forward edge 132 (Figure 10) is made so as to run obliquely from top to bottom. The arrangement must be such that the front point 122 of the needle lifter is screened by the surface 130 which is bent over at a right angle.

Should it occur during the motion of the lock in the direction of the arrow D that the rounded edge of the needle heel should by chance at the place 135 (Figure 12) strike against the edge 132 of the deflecting element 126, quite definite forces will be exerted on this edge. In the elevation projection, as shown in Figure 10, the direction of the force 136 is perpendicular to the forward edge 132 of the deflecting element. In order clearly to comprehend the effect of this force on the deflecting element, let this force be resolved into the two components 137 and 138, of which one, the force 137, runs vertically and the other, the force 138, horizontally. The vertical force 137 acts in the sense of lifting the deflecting element, whilst the horizontal force 138 is counteracted by the resistance forces at the fixing place, more particularly at the rivets 127 and 32. Similar are the force relations in side elevation, which is represented by Figure 12. In this figure 139 represents the direction of the force which is exerted by the needle heel 143 at 135 on the front edge 132 of the deflecting element. This force can also be resolved into two further components 140, 141, of which the vertical force 140 acts in the sense of lifting the deflecting element.

In the position shown in Figure 10 this lifting force 137 need only be relatively small, as the edge 132 has to be lifted only by the amount 142, in order to allow the heel 143 of the needle to pass through under this edge, until it strikes against the inclined surface 121 and there slides along in the direction of the arrow F.

Should the needle heel 123, however, be in a position further to the right according to Figure 11, there will still be an upwardly directed component 137 of the force. This component would, however, in the position shown in Figure 11 not be sufficient to lift the deflecting element through the considerably greater distance 144, which would be necessary for allowing the needle heel to pass through under the edge 132. The needle heel will therefore move along the forward surface 130 of the deflect-

ing element in the direction of the arrow G, finally leaving this surface 130 and passing on to the right-hand inclined surface 120 of the needle lifter.

It will be understood from the above, that through the deflecting member the danger is completely avoided; that the needle heel might block the lock in its motion in any possible position. The needle heel will be deflected either to the right or to the left from the point 122.

In the constructional form of Figure 13 the riveted connection 127 is replaced by a hinge 146. In order to obtain the effect of the spring force, namely the limitation of the upward motion of the deflecting element on striking the needle heel, there is provided in this case, where there is no spring force, a stop 147, as shown purely diagrammatically in Figure 13.

According to an older proposal, the accurate adjustment of the loop density takes place after the release of a milled nut by displacing the needle sinker in a slot. For accurate adjustment an index was provided, which moved along a scale. Accurate adjustment is frequently not obtainable with this arrangement, for the reason that it depends greatly on the carefulness of the worker.

Accurate adjustment is of special importance, where in making two similar knitted articles with the same number of courses it is desired to obtain the same length and between the knitting of the two parts the loop density has been altered. When, after finishing one piece, for instance the sleeve, the second sleeve is to be knitted, it is necessary to use the greatest accuracy to ensure the size of loop, when making the second piece, exactly the same as with the first piece. Otherwise the second piece would be shorter or longer. In such case particularly great accuracy is essential, since even very small errors will, owing to the great number of courses, add up to relatively great error. Thus, differences of a fraction of a millimetre in the adjustment of the needle sinker may amount in the final result to differences of several centimetres in the length of sleeve, as in the case of the length of a sleeve it is on the average a matter of 200 to 300 courses of loops.

A further disadvantage of the adjusting arrangement according to the older proposal consists in the danger of the clamping screw working loose, so that undesirable changes in the loop density may occur, while knitting is proceeding, which frequently go entirely unnoticed or are noticed too late.

These disadvantages are avoided according to the present invention through the adjustment of the needle sinker being effected by a sliding cam drive of a rotatable disc. For this purpose the guiding piece 54 (Figure 14) of the needle sinker 101 is provided with a pin 107 which on the front side of the lock plate 53 engages in a spiral cam 108 of a rotatable disc 109. As may be seen from Figure 16, the spiral cam there is constituted by the outer peripheral surface or edge of a recess 109a formed in that side of the adjusting disc 109 which faces the lock plate 53. Along the surface of the spiral cam notches or grooves 111a are provided at regular intervals. The pin 107 of the needle sinker is pressed against the spiral cam through a helical spring 115 laid round the guiding piece 54. This helical spring 115 is disposed at the rear side of the lock plate in the free space between the lock plate and the needle sinker 101. The hook-shaped ends of the helical spring 115 are hooked into notches 116 in the form of circular segments punched out of a bar 117.

The adjusting disc 109 is supported so as to be capable of rotating about a pivot pin 118 fixed in the centre of the lock plate 53. Upon rotation of the adjusting disc 109 in the direction of the arrow p, the pin 107, sliding along the spiral cam 108, will successively enter the separate notches 111a. By this means the needle sinker is moved step by step in the direction of the arrow q.

In order to make the position of the adjusting disc 109 at any time visible from the outside, there are

arranged in a depression 150 on the front side of the adjusting disc numerals 1 to 10 in a circle so as to correspond in position to the individual notches. This depression is covered to the outside by a cover plate 151 which is fixed to the pin 118 by a screw 152 in such a manner that it does not take part in the rotation of the adjusting disc 109. At one place in the cover disc is a circular window 153 (Figure 19) in which, on the adjusting disc being turned, the numerals will appear and thereby indicate, in which position the needle sinker 101 happens to be.

Through this adjusting device operating with notches an indication is given in a positive manner, that always re-occupies exactly the same position, so that the above-described differences in the production of a knitted article, through inaccurate adjustment to a definite width of loop, will no longer occur. A further advantage of the novel adjusting arrangement resides in its convenient manipulation. There is no longer any exact and troublesome adjustment of the needle sinker requiring under certain circumstances the use of a magnifying glass. The needle sinker snaps automatically into the correct notch position each time. Finally, any unintentional displacement during knitting is excluded.

In the hitherto usual constructional form the needles could only be rendered inoperative by being pushed downwards, as the auxiliary needle sinkers 43, 44 filled the upper part of the lock plate to such an extent that at this place there was insufficient room for the needle heels to slide past. In the novel constructional form the individual parts of the lock are placed together more compactly, more particularly the auxiliary needle sinkers have less width, so that between them and the upper edge of the lock plate there is sufficient space for the passage of the needle heels. The needles can thus be put out of operation both by being pushed downwards as well as upwards.

On the other hand, sufficient space can be obtained above the auxiliary needle sinkers for the passage of the needle heels by widening the needle bed and to a corresponding extent the carriage of the lock as well.

For normal knitting it would suffice to put the needles out of operation in the lower position only. The possibility of putting the needles out of operation in the upper position as well has been found to be of importance, when stocking heels are to be knitted with the hand knitting appliance under consideration. For this purpose it is necessary, after finishing the stocking leg, to put the needles lying at both sides of the leg part out of operation by displacing them upwards. This applies to those needles which are not required for forming the stocking heel. Only about half the needles occupied by loops and lying in the middle of the knitted piece are in operation. When knitting with these still operative needles, each time after the completion of a stroke of the lock motion one needle is additionally put out of operation alternately on one side and then on the other. In this way work proceeds until a minimum width is reached, whereupon alternately in the opposite sense on one side and the other the needles are put in operation again, until the same width of knitting is reached as that at the commencement of the starting of the heel. In this way the usual pocket-shaped heel is formed. After finishing the heel, all the needles are again put in operation and, by continuing to knit, the foot part of the stocking is commenced.

This putting out of operation of certain needles into the upper position provides the further possibility of producing patterns, through needles in regular succession, for instance each alternate needle, being pushed by hand into the upper inoperative position. In this position individual courses of stitches are then knitted by pushing the lock to and fro. Thereupon, the previously inoperative needles are returned into the middle operative position, the so-called insertion position, and knitting proceeded

with in the usual way. The known cardigan stitches are produced in this manner.

In order to prevent the needles which are in the upper or lower inoperative position and therefore within the range of the lock from getting between the individual lock parts through unintentional displacement, a bar 155 is provided at the lower edge of the needle lifters 33, 34 (Figure 14) and a bar 117 is provided at the upper edge of the needle lifters 43, 44, which bars extend from one end of the lock to the other. The needle heels can strike against these bars. They are prevented by these bars from penetrating unintentionally into the separate channels of the lock.

As the needle heels in the constructional form under discussion can be brought both into the upper as well as into the lower inoperative position, there are danger points on each side of the lock in the region of the needle lifters on the one hand and of the auxiliary needle sinkers on the other hand. Even if these needle lifters and needle sinkers should be made wedge-shaped towards both outer sides of the lock, unfavourable cases may occur, where the needle heels strike against the wedge point and would block the lock. For this reason the deflecting elements are used, such as were described with reference to the previous constructional example.

For the sake of simplicity these deflecting elements are constructed as double deflecting elements 160 which are fixed in the middle between the two bars 155, 117, each by two screws 161, to the lock plate 53 in such a manner that the two flat parts 162, as shown more particularly in Figure 17, extend obliquely downwards towards the two free ends, so that they can yield flexibly, when the needle heels strike against the inclined edges 167. The surfaces 130 extending perpendicularly to the surface of the lock plate are so arranged with respect to the wedge points of the needle lifters or auxiliary needle sinkers that the rear edge 164 of these surfaces 130 practically coincides with these wedge points. There is a variation as compared with the arrangement according to the invention described with reference to Figures 9 to 13 in so far as in that case this surface 130 (cf. Figures 9 and 10) extends backwards beyond the wedge point 122 and proceeds for a certain distance parallel to the upper obliquely rearwardly extending wedge edge 120.

According to a further idea forming part of the invention, the actuating knobs 31, 31a of the needle sinkers are not placed next to the handle 170 of the lock, but within the space surrounded by the handle (see Figure 16). One advantage of this arrangement is that while knitting, the worker will not get caught on these knobs inadvertently with bits of thread of clothing. A further advantage consists in that inwardly extending extensions 171 of the handle may be used for the reception and guiding of the pins 172 and for catch arrangements. Not the least advantage is a pleasing appearance. The provision of the extensions on the handle is also of considerable advantage for the secure fixing of it, by enlarging the bearing surface on the lock plate. This for the first time provides the possibility of making the handle of artificial pressed material, without the danger of breakage.

Round the pins 172 there is a sleeve 173 which is riveted firmly into the lock plate 53. In the middle of the sleeve there is at one place a bore 174, into which a ball 175 is inserted, which is brought by a divided annular spring 176 into one or other of the two annular grooves 177, so as to catch there through pressure or tension being exerted on to the actuating knobs.

The handle 170 is already connected with the lock plate 53 by the sleeves 173. An additional connection is established by the screw 179.

In order to enable the hand knitting appliance to be conveniently transported, it may be of advantage to make the handle capable of being folded down or com-

pletely detachable and to attach it to the long narrow side of the hand knitting appliance. For carrying it the hand knitting appliance can then be held by the handle like a suitcase.

In the first constructional form the member for holding down the tongs of the needles had the form of a simple, one-piece wire member. According to the proposed improvement the member is made divided and onto its two ends sleeves **180, 180'** (Figure 14) are slipped, each of which carries a row of bristling tufts **181, 181'**. This arrangement is well known in connection with flat knitting machines.

Constructions of hand knitting appliances are known where, even though sinkers are used, it is not necessary to make the needle sinkers capable of being put out of operation. It has been found, however, in practice that the putting out of operation of the needle sinkers may be of the greatest advantage for certain knitting operations, this making it possible to undo individual courses of stitches, whilst the knitted piece is still in the hand knitting appliance.

Thus, it is necessary for the undoing operation, to bring the needles into the tensioning position, that is to say into the position in which the needle heads lie somewhat behind the front sinker edges. The undoing operation is then as follows:

The thread end **190** (Figure 20) is, by being moved downwards in the direction of the arrow *r*, unhooked from under the hook of the sinker **191** and thereupon, as shown in Figure 21, moved upwards in the direction of the arrow *s*, a pull being exerted at the same time on the thread in the direction of the arrow *t*. By this means the loops **192, 193** lying below it are drawn upwards and at the same time the upper loop **194** in the needle hook **195** shortened, the loop **192** of the previous course of loops hooking itself into the needle hook **195**, as will be seen from Figure 22. This produces the state, as shown in Figure 20, with the sole difference, that the undoing process has moved forward to the right by the pitch of one needle. The process of undoing is then repeated in the same manner as already described.

A further advantage of the disengageable needle sinker consists in that it is possible to knit with several colors, even when the change of color is effected successively in an uneven sequence of numbers. Such a change of color shall now be described in detail: For instance, it is intended to knit alternately one course with white thread and the following with red thread. If the lock were not to be provided with needle lifters capable of being put out of operation the following difficulty would be encountered:

When knitting for instance with a red thread from left to right, then after the first movement of the lock, the red thread end will be to the right. On moving the lock from right to left, at the same time placing a white thread into the needles, the white thread end will appear on the left hand side. If the third course from left to right is to be knitted with the red thread, there will be no red thread end, as it is on the right-hand side. It will be seen from this, that it will be necessary in this stage of the knitting operation to knit from left to right a so-called "odd course," that is during the lock motion from left to right not to knit a fresh course of stitches. This is only possible, however, when the right-hand needle lifter is capable of being put out of operation. The result of this will be that, when knitting the second course, that is during the lock motion from right to left, the needle will remain in the tensioning position. The needle lifter is then again brought into the operative position and the lock moved from left to right, so that the needles are pushed out of the needle bed into the insertion position. Consequently, the carriage will again be to the right, where the red thread end is, so that the third course can be knitted with the red thread from right

to left. In this way any courses can be knitted with any colors.

When starting to knit, care must be taken that the beginning of one thread is fixed at the left side of the appliance and the beginning of the thread of different color at the right side of the appliance.

Through the putting out of operation each time of the corresponding needle lifter, the total movement of the needle is divided into two phases: On one traverse of the lock taking place, the needles are brought into the tensioning position, that is to say into the position in which the needle heads lie just behind the sinkers, whilst on the return traverse of the lock the needles will be thrust out into the insertion position. Thus, the complete to and fro motion of each needle, which otherwise takes place during a single traverse of the lock, is as it were distributed over two traverses of the lock, namely over one forward stroke and one backward stroke. In this way it becomes possible to bring the lock each time to that side of the needle bed where the thread of the desired color is.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. In a hand-operated knitting appliance having latch needles arranged for reciprocal movement in respective guides of and transversely to a needle bed, a lock arranged for reciprocal displacement longitudinally of said needle bed, a needle actuator carried by said lock for imparting to said needles said reciprocal movement upon reciprocal displacement of said lock, and a plurality of sinkers projecting partly beyond the forward edge of said needle bed and arranged for oscillating movement parallel to each other in bottomed guide grooves provided on said needle bed and intermediate said needle guides, respectively; each of said sinkers comprising a lever with first and second arms disposed at an obtuse angle with respect to one another, each first arm being provided, at a first location remote from the junction between the same and the corresponding second arm, with upper and lower front end portions offset with respect to one another to form a downwardly facing hook adjacent and beyond said forward edge of said needle bed, each of said sinkers being provided with a downwardly opening recess at said junction of said first and second arms, a wire extending along said needle bed and transversely to said sinkers and engaging in said recesses to support said sinkers and to provide a common axis of oscillation for the same, said front end portions of each of said first arms being curved about said axis of oscillation of its respective sinker, and respective spring means operatively connected to each of said first arms of said sinkers between said recess and said front end portions thereof and biasing said first arms, respectively, toward the bottoms of said guide grooves.

2. In a knitting appliance according to claim 1; adjustment means operatively connected to a portion of said needle actuator for adjusting the same transversely to the direction of displacement thereof together with said lock to thereby enable variation of the density of loops formed by said needles, said adjustment means including rotatable cam means, and resilient means urging said portion of said needle actuator into contact with said cam means, whereby rotation of said cam means effects said adjustment of said needle actuator.

3. In a knitting appliance according to claim 2; said rotatable cam means including rotatable disc means provided with a spirally arranged cam surface, said cam surface being provided with spaced notches, said portion of said needle actuator engaging said cam surface and said adjustment of said needle actuator being effected in response to rotation of said disc means.

4. In a knitting appliance according to claim 2; needle

13

lifters carried by said lock and located, respectively, in the paths of movement of the heels of said needles and each provided with outwardly directed edges and with inclined converging surfaces terminating in a point, whereby said heels of said needles strike successively against a respective one of said inclined surfaces and are deflected by and along the latter during continued displacement of said lock along said needle bed.

5. In a knitting appliance according to claim 3; deflecting means for said needle lifters, respectively, said deflecting means extending longitudinally of respective needle lifters and each being provided with an outwardly extending inclined edge, each inclined edge being bent to extend in transverse direction to its respective needle lifter to shield the point of said needle lifter, whereby damage to said needle bed and to said needles from contact between said points and said heels of said needles, respectively, is prevented.

6. In a knitting appliance according to claim 1; a cam piece mounted on said lock and having a contact surface arranged for sequential engagement with said second arms of said sinkers as said lock is displaced along said needle bed, said contact surface being of circular curvature with the center of curvature located on said axis of oscillation of said sinkers.

14

7. In a knitting appliance according to claim 1; each of said first arms of said sinkers being provided intermediate said front end portions and said recess with a slot of substantially circular cross-section and having a downwardly facing opening which is narrower than the widest portion of said slot, a tie-rod having a substantially spherical head at one end engaging in said slot and having a shoulder at its other end, said tie-rod extending through said opening of said slot and through said lock, each of said spring means comprising a compression spring interposed between said lock and a respective one of said shoulders and effecting said biasing of said first arm of the corresponding sinker toward the bottom of its respective guide groove, each slot being open laterally of its respective first arm, whereby each sinker may be disconnected from its tie-rod only by being laterally shifted along said wire, disconnection of said sinkers from said tie-rods being otherwise prevented.

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