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Filed Sept. 16, 1937

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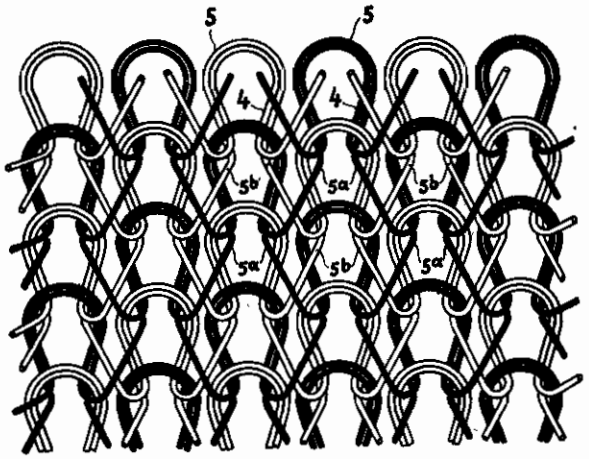
Abb.1



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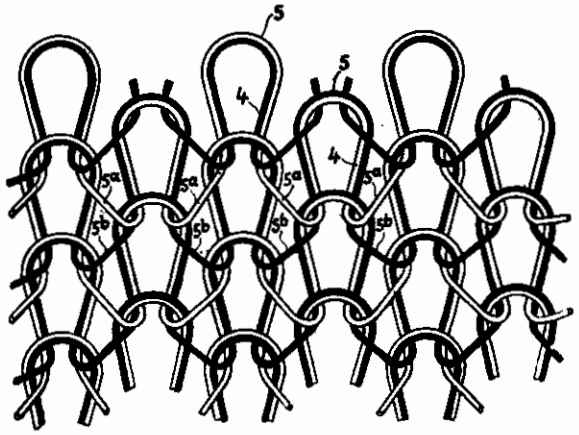

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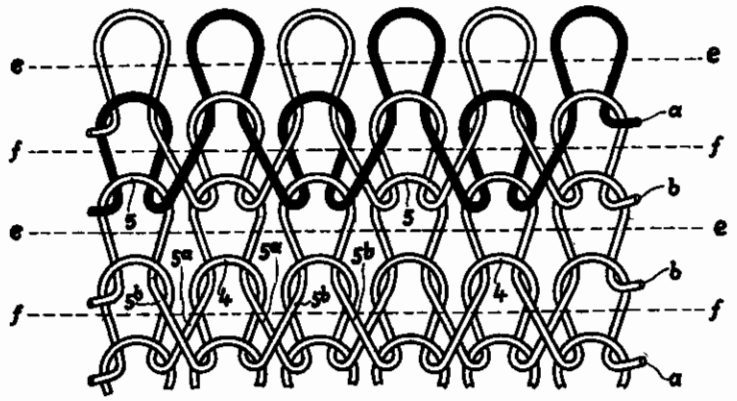
Abb.3



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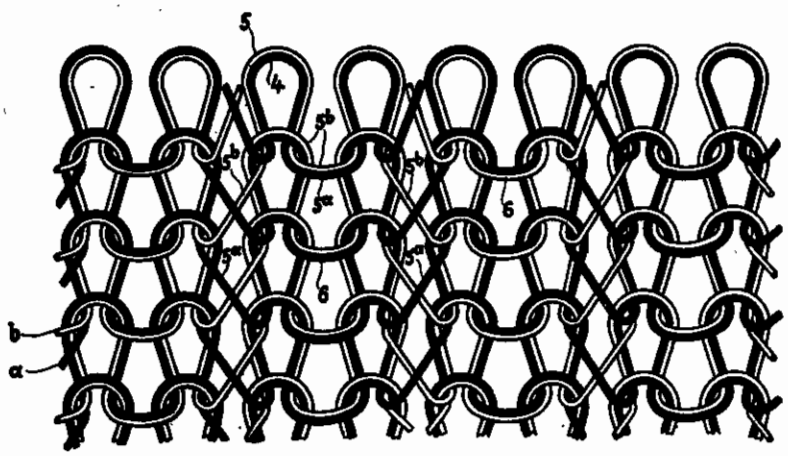

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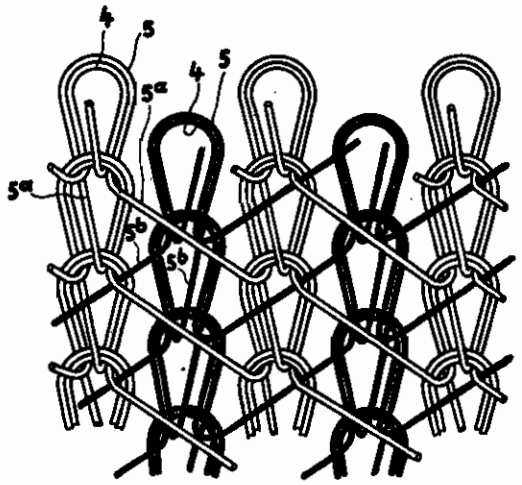
Abb.5



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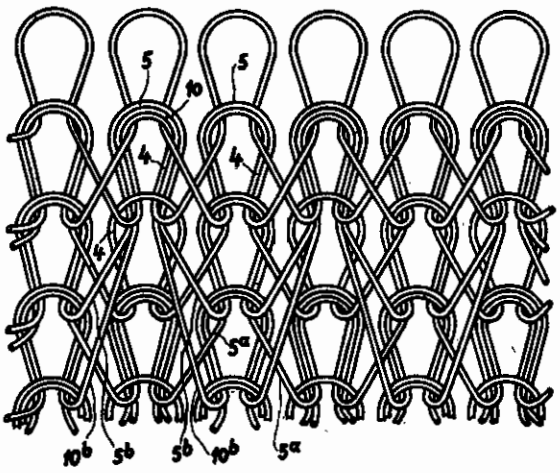

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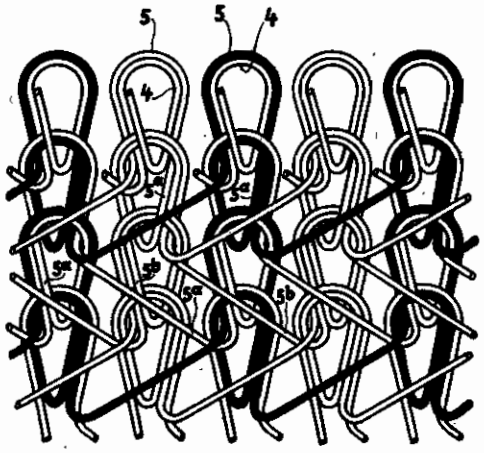
Abb.7



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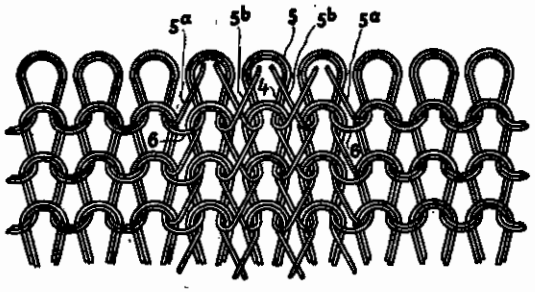

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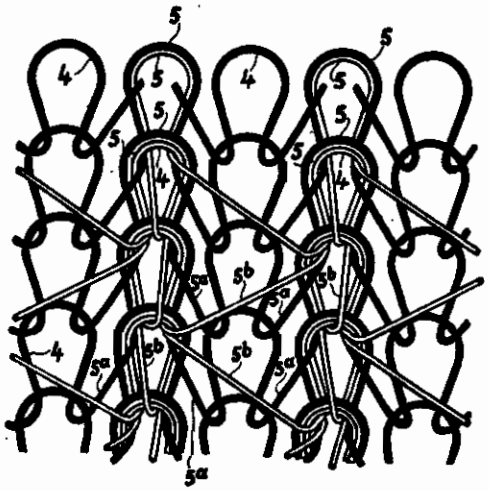
Abb. 9



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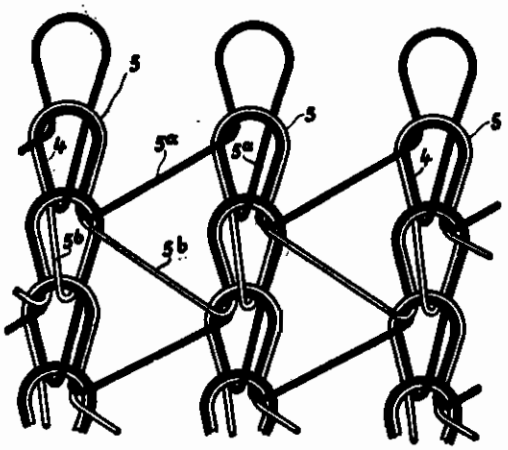

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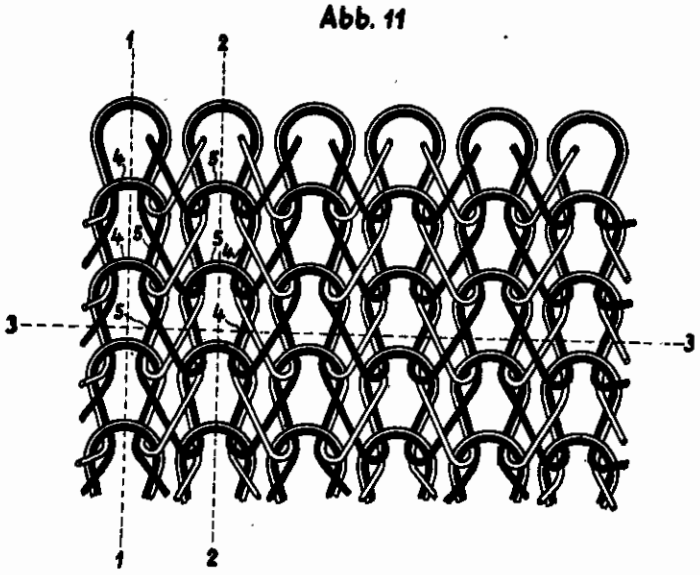
Abb. 11



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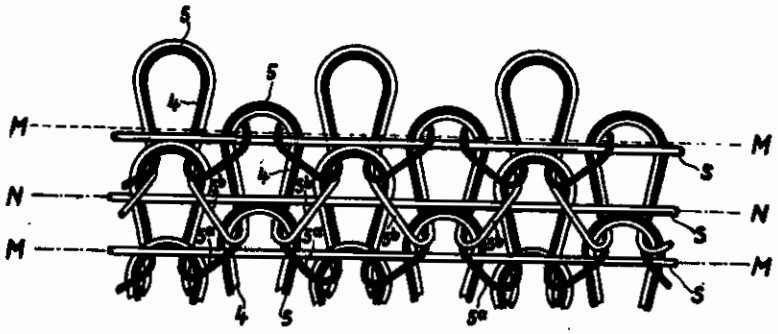

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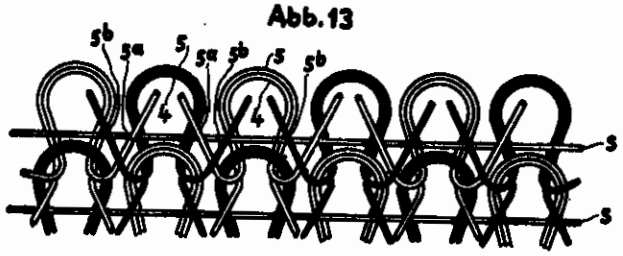

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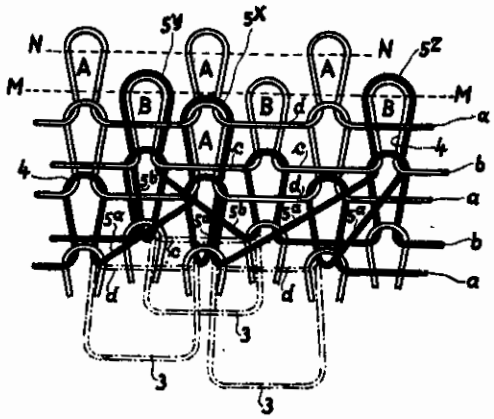

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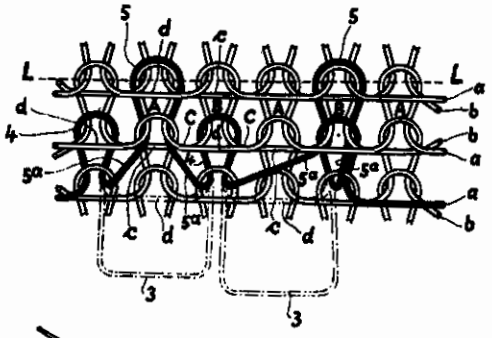

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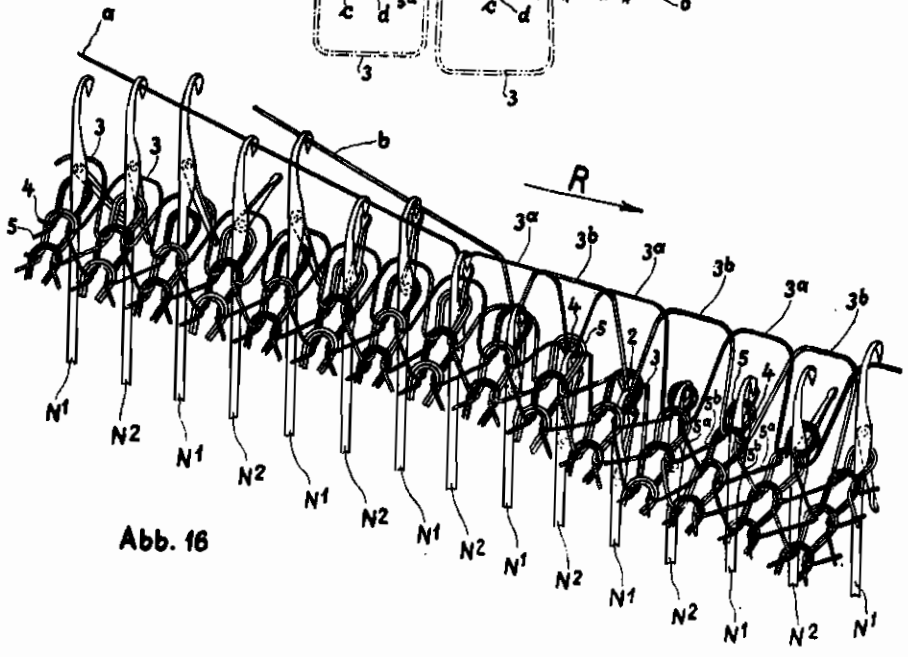

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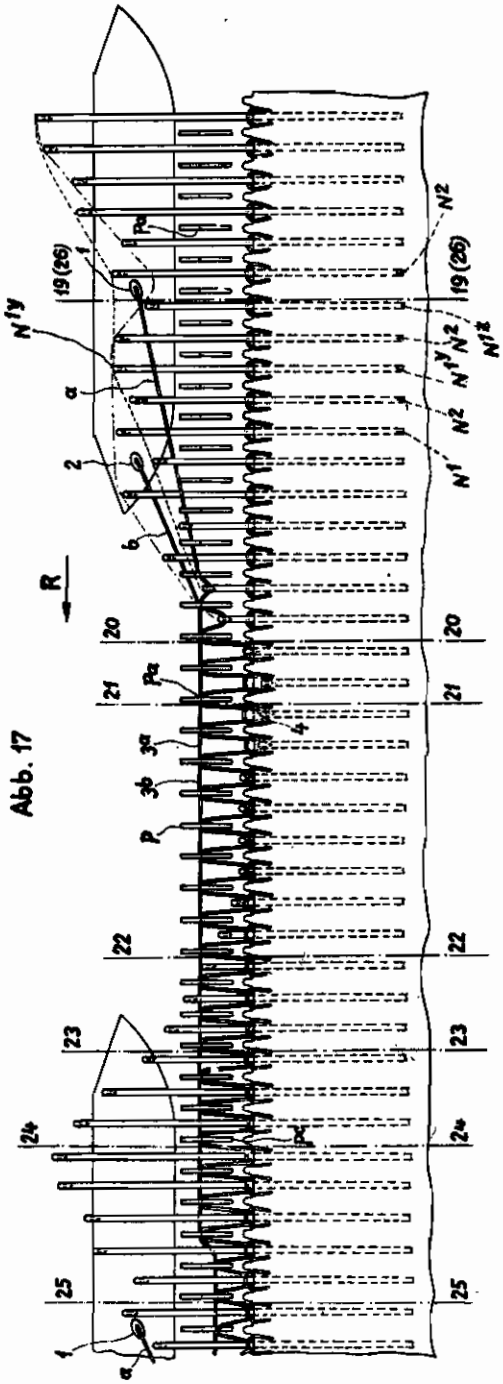

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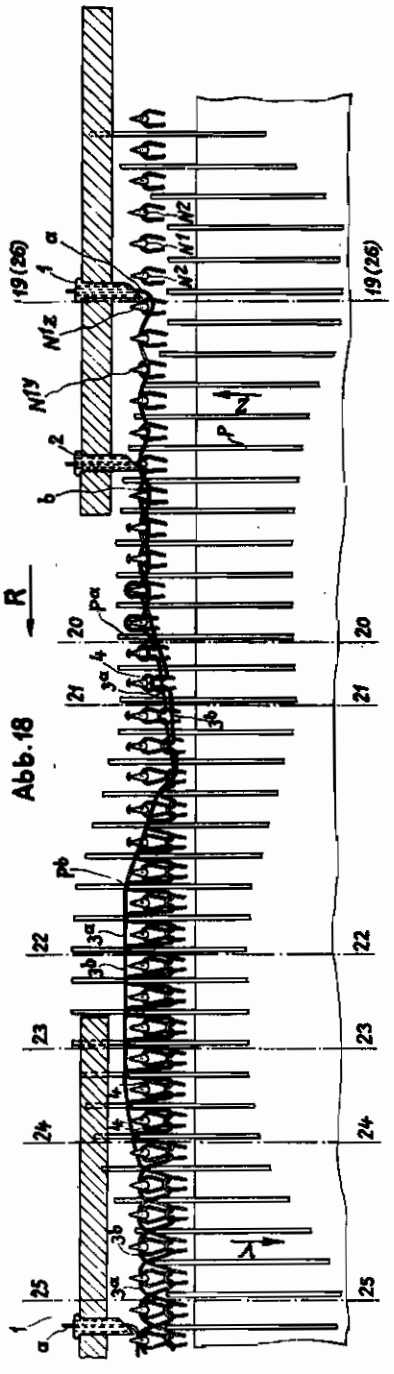

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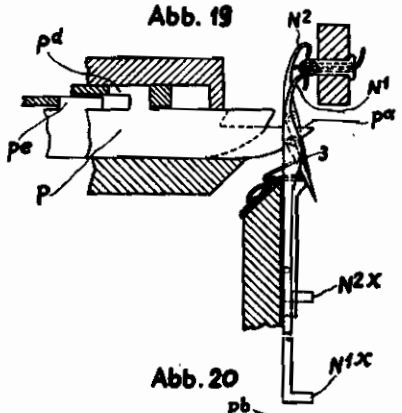
Abb. 19



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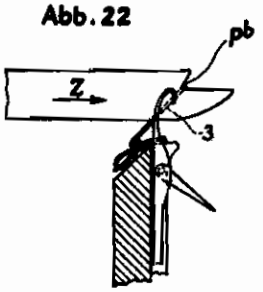

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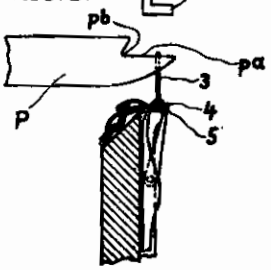

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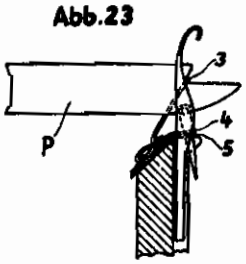

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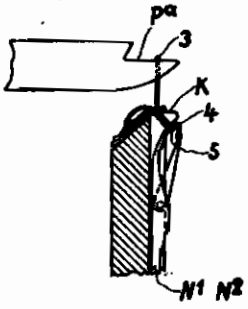

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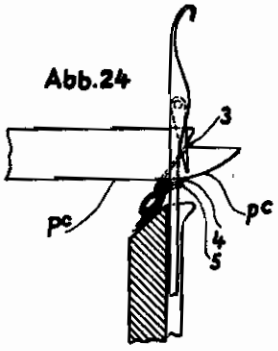

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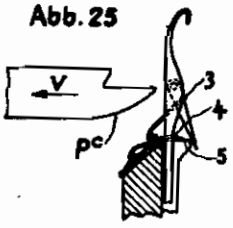

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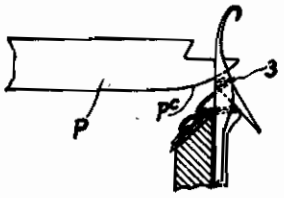

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Abb. 27

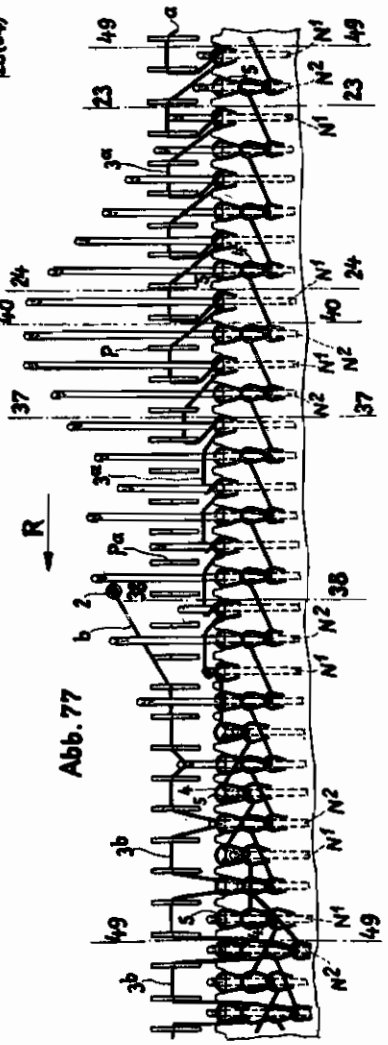

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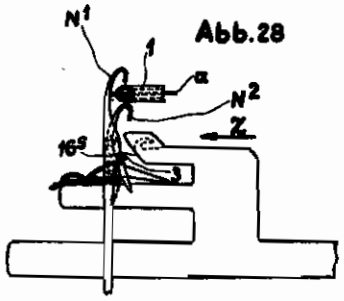
Abb. 28



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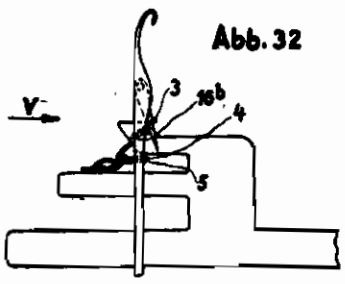

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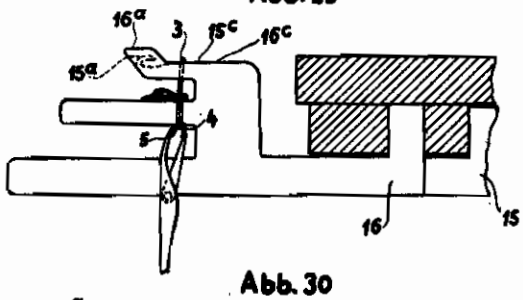

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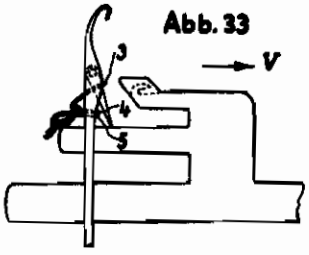

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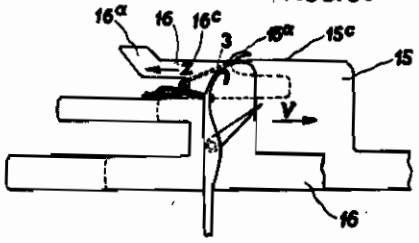

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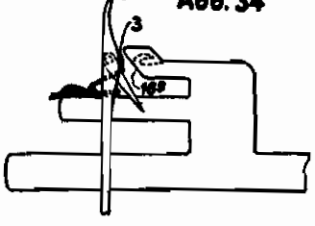

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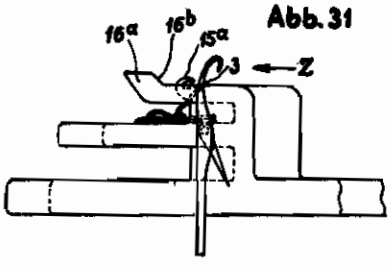

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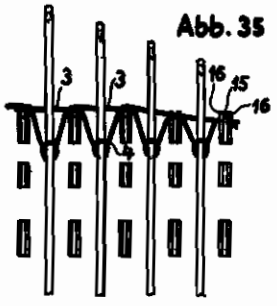

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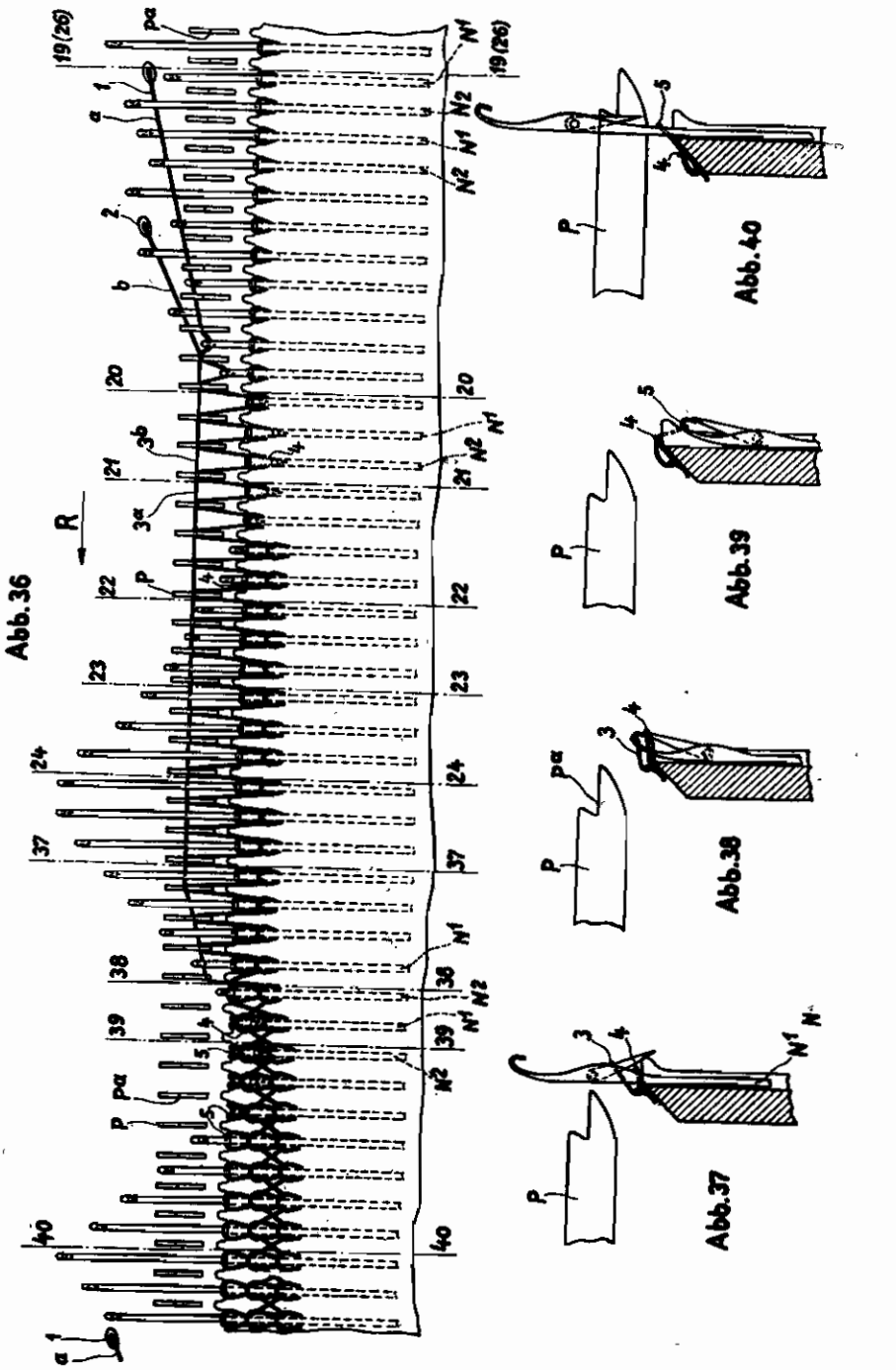

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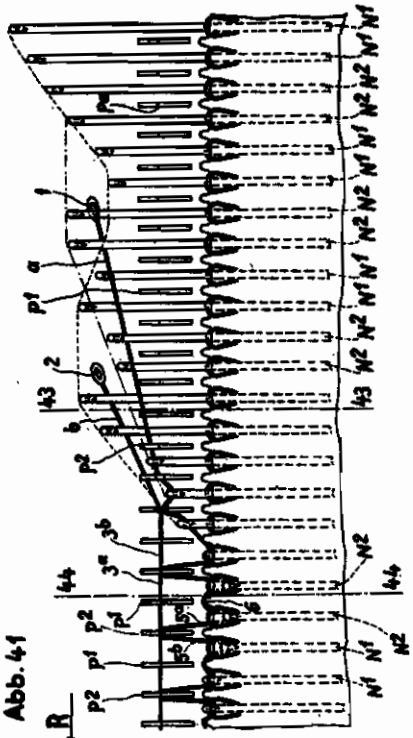

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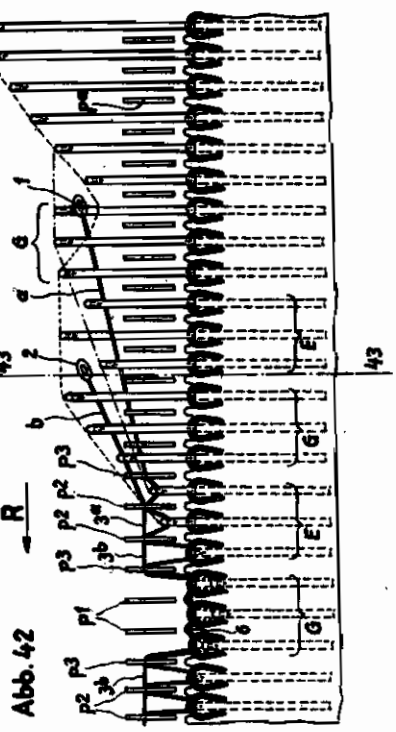

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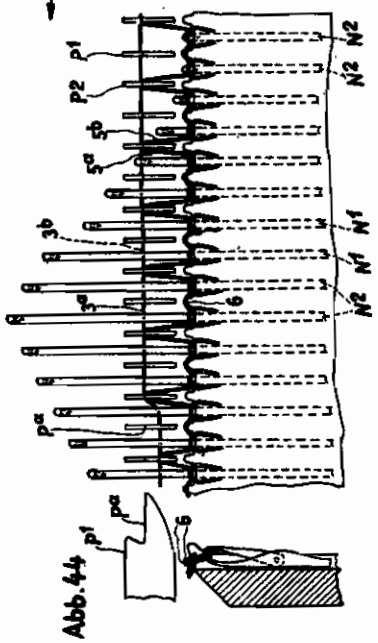

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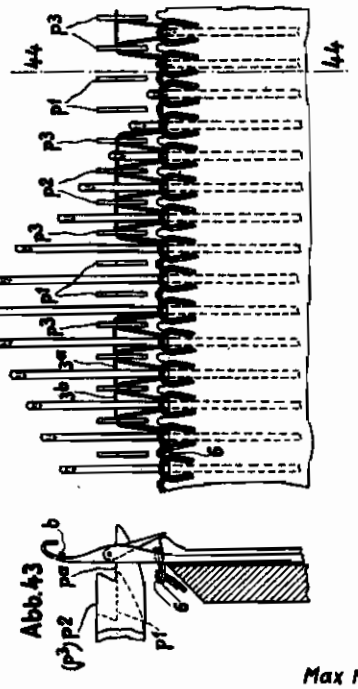

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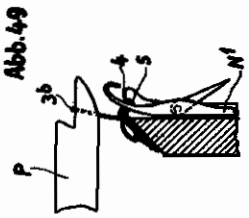

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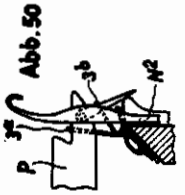

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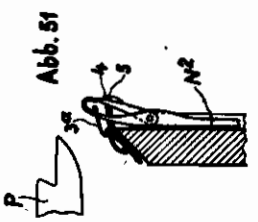

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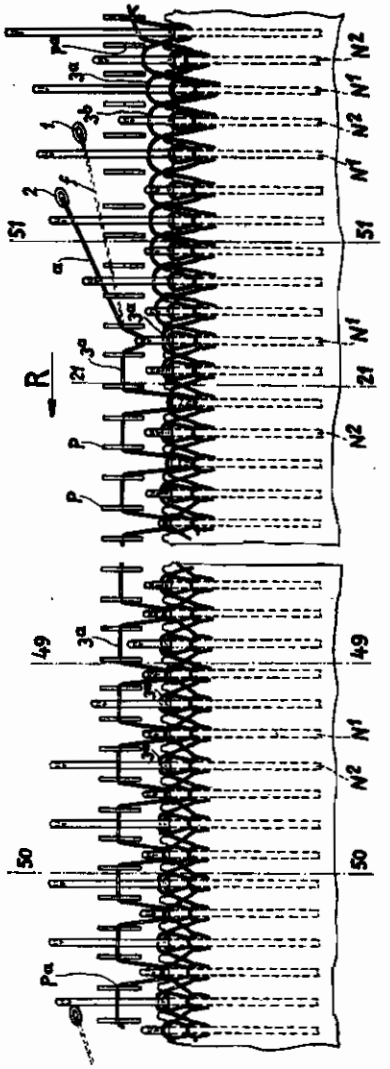

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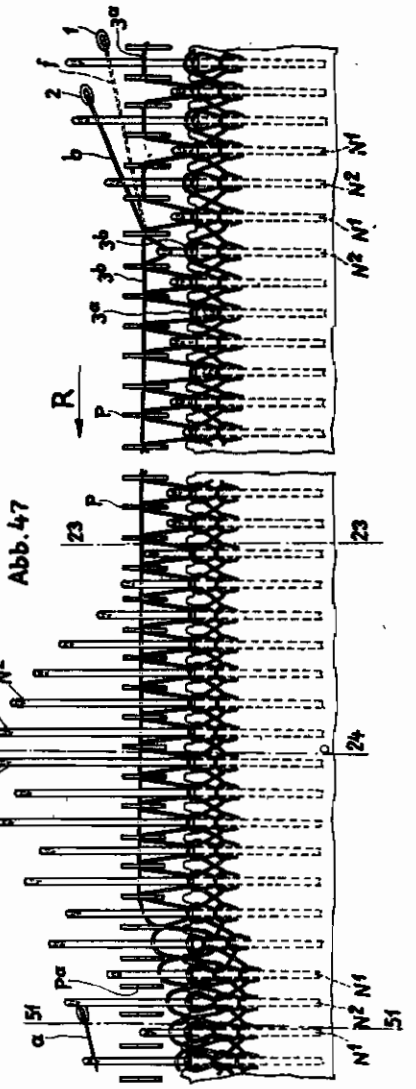

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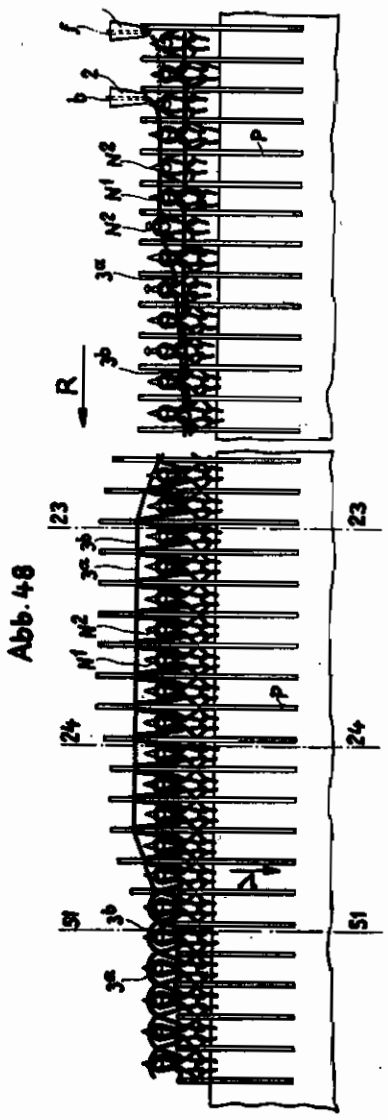

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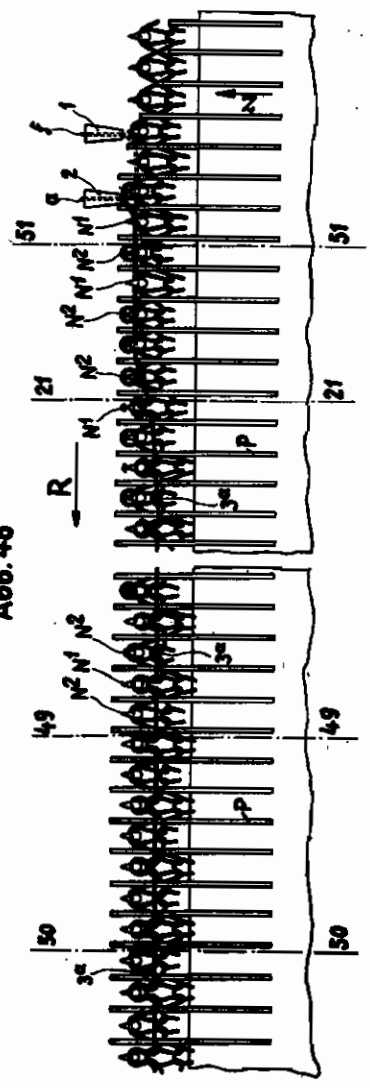

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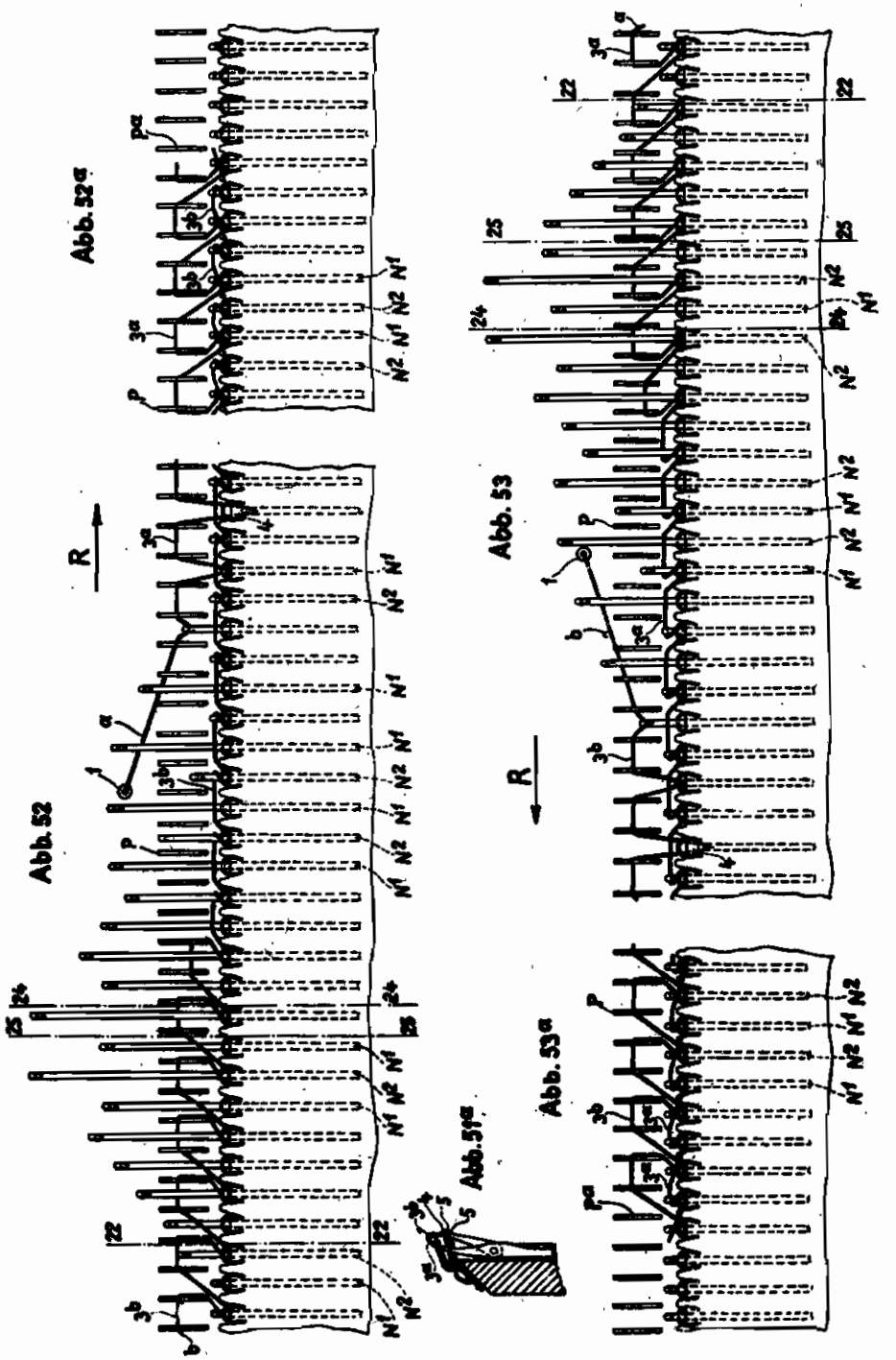

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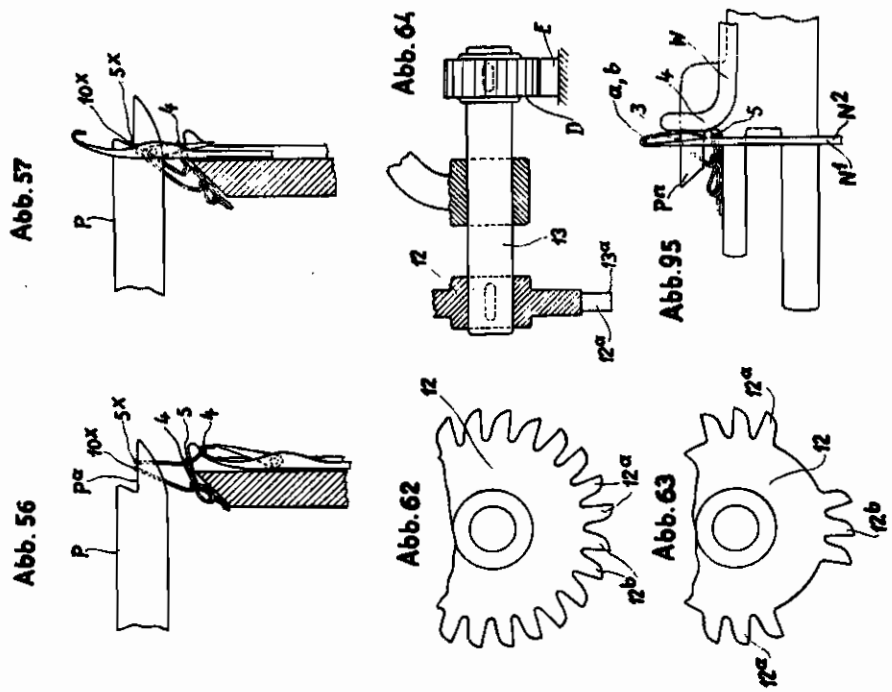

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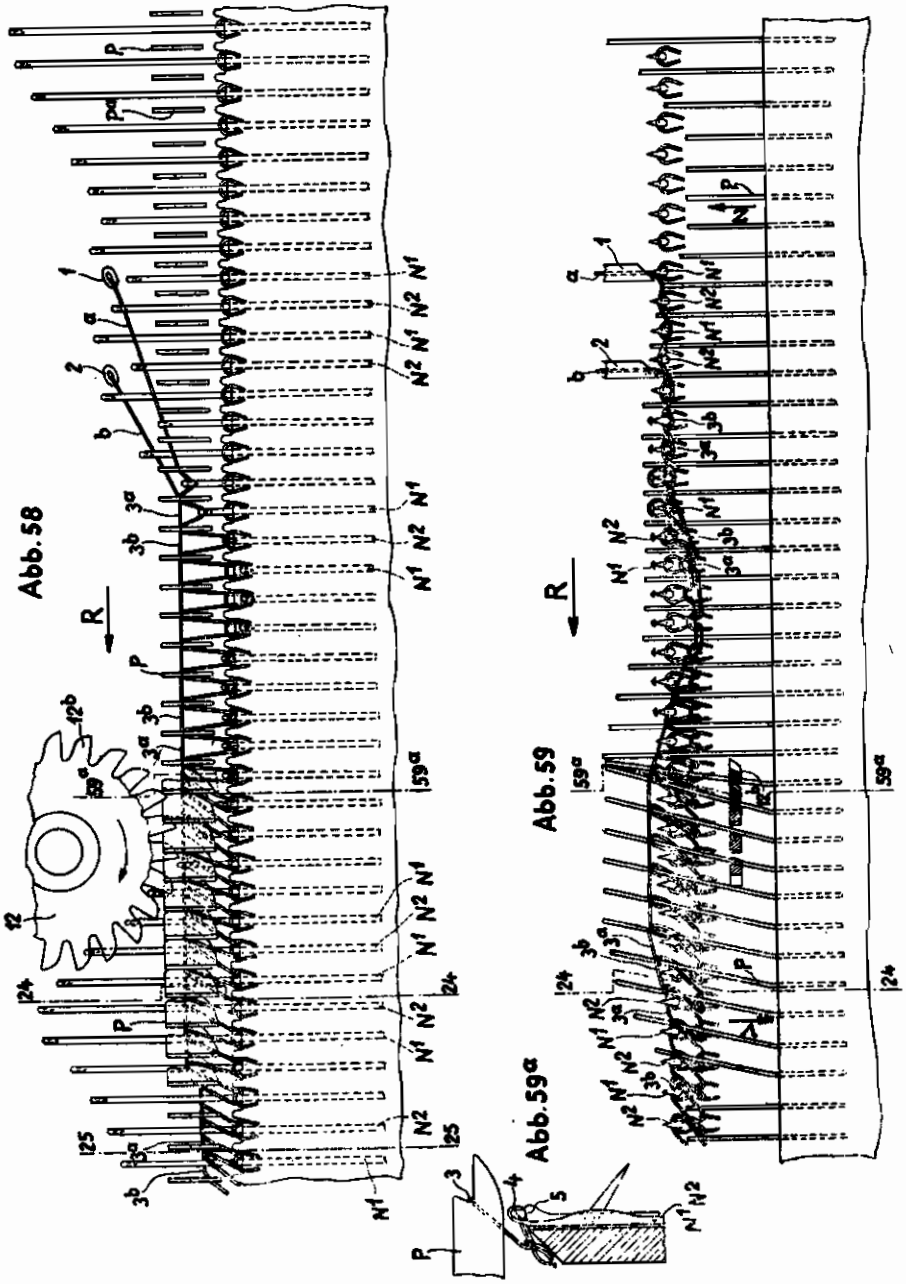

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M. NEBEL
KNITTING MACHINES AND METHOD OF OPERATING SAME FOR KNITTING FABRICS
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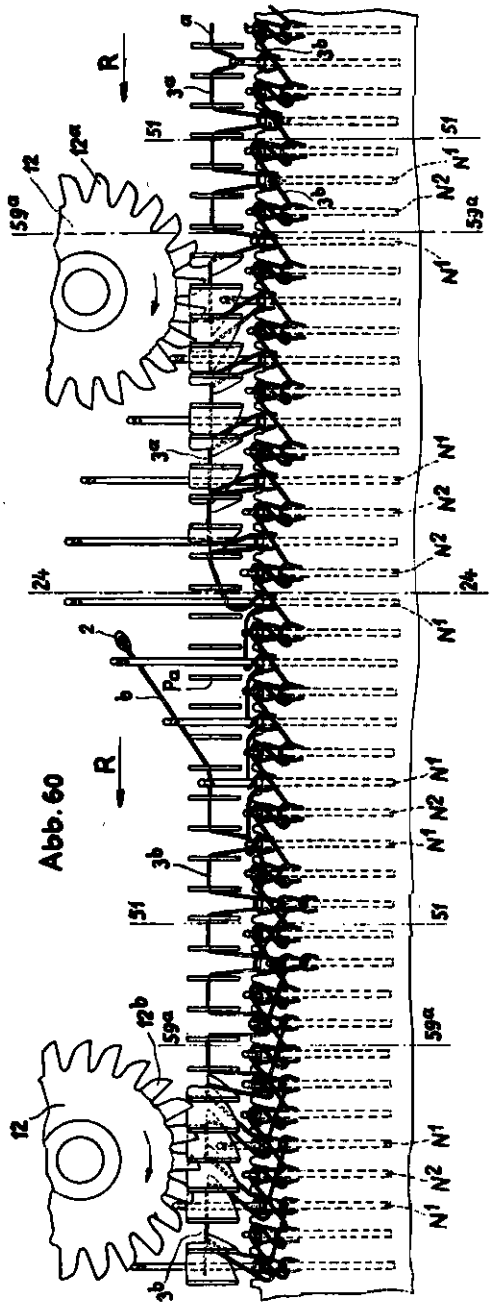
25 Sheets-Sheet 19



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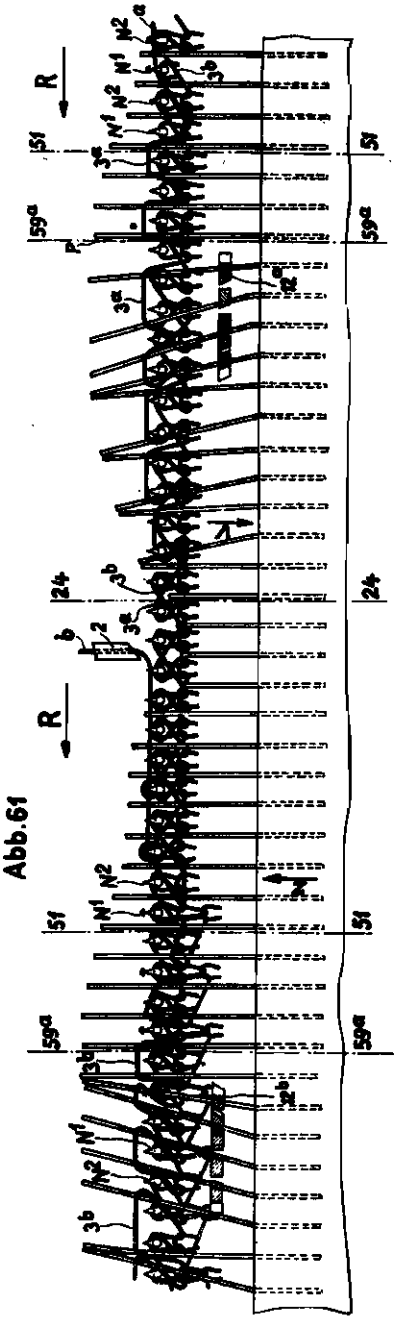

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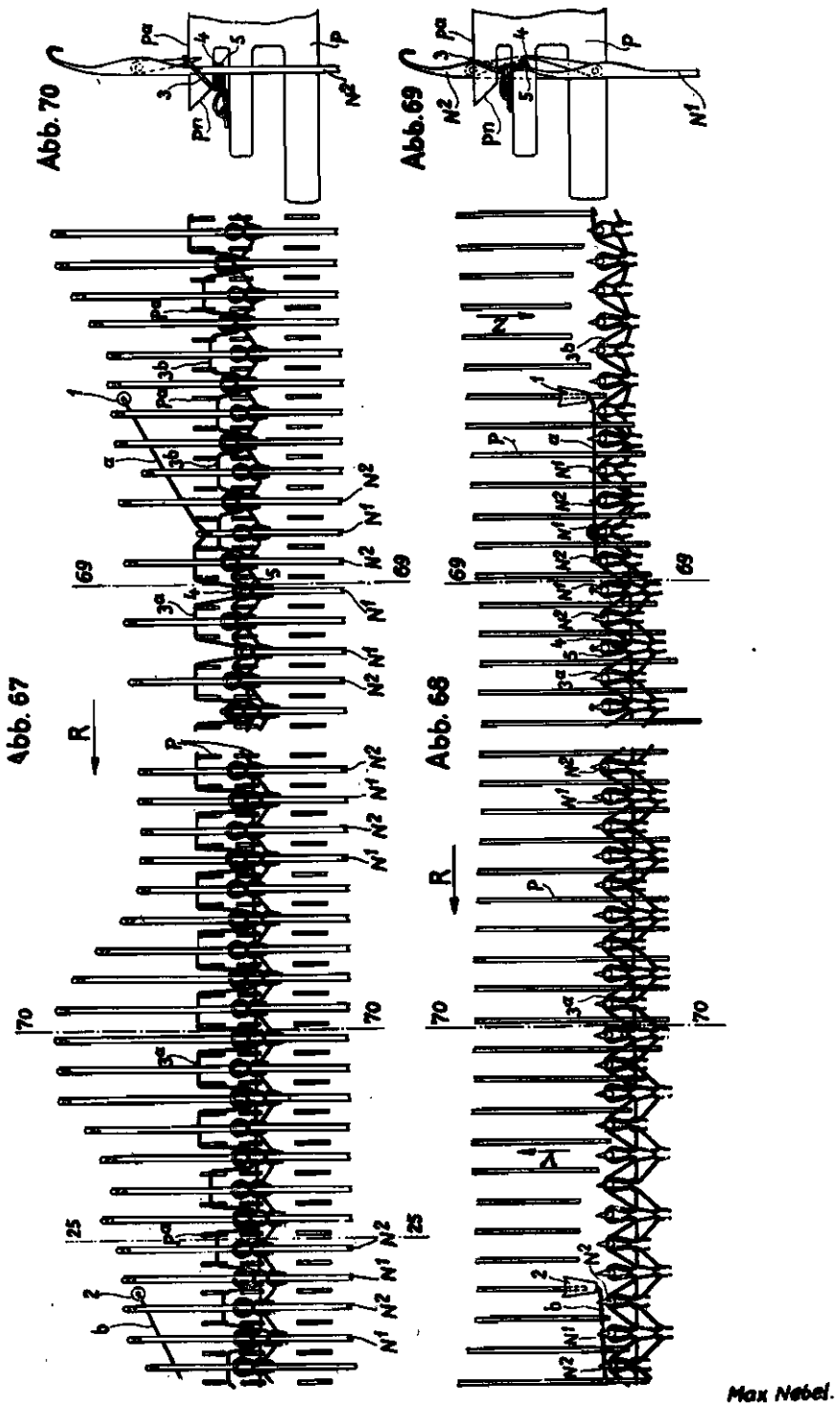
25 Sheets-Sheet 20



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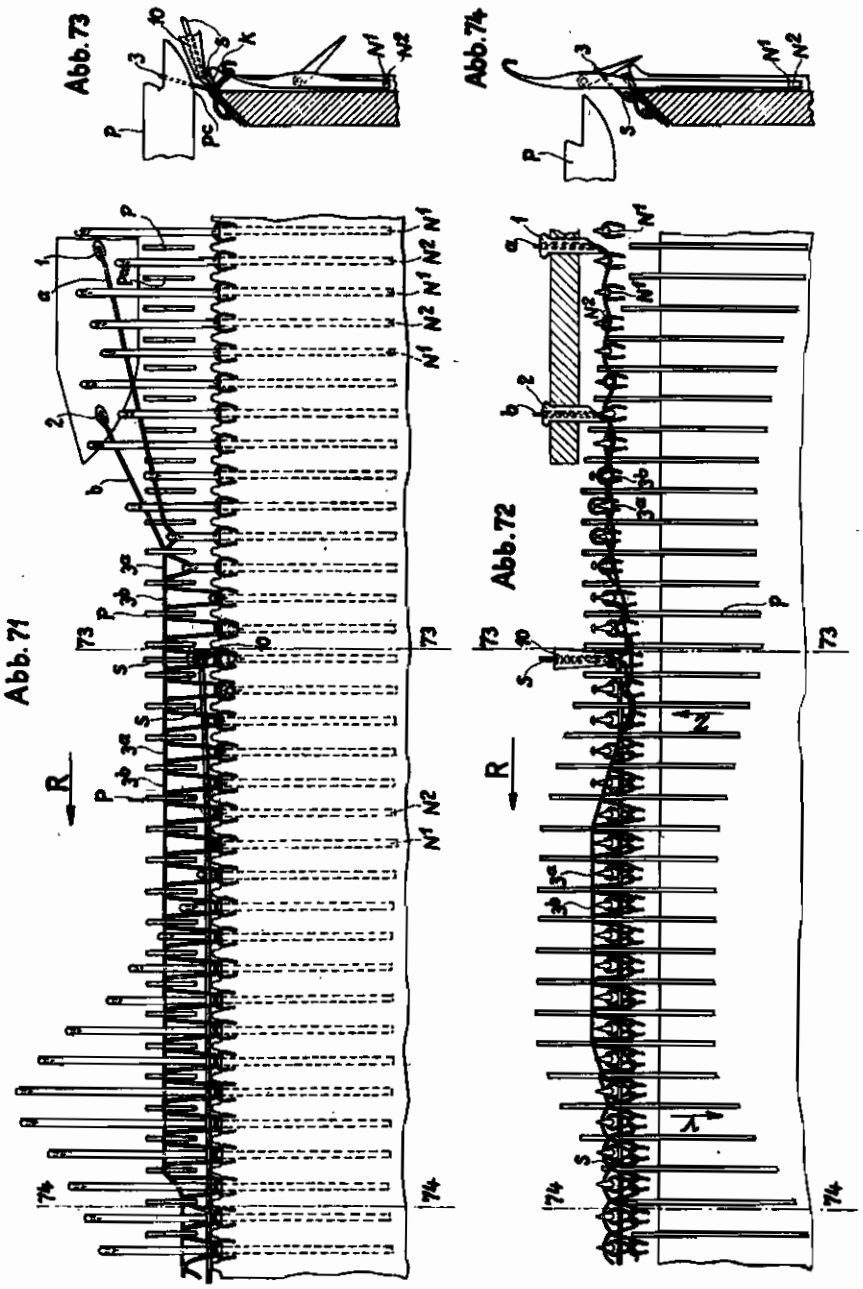

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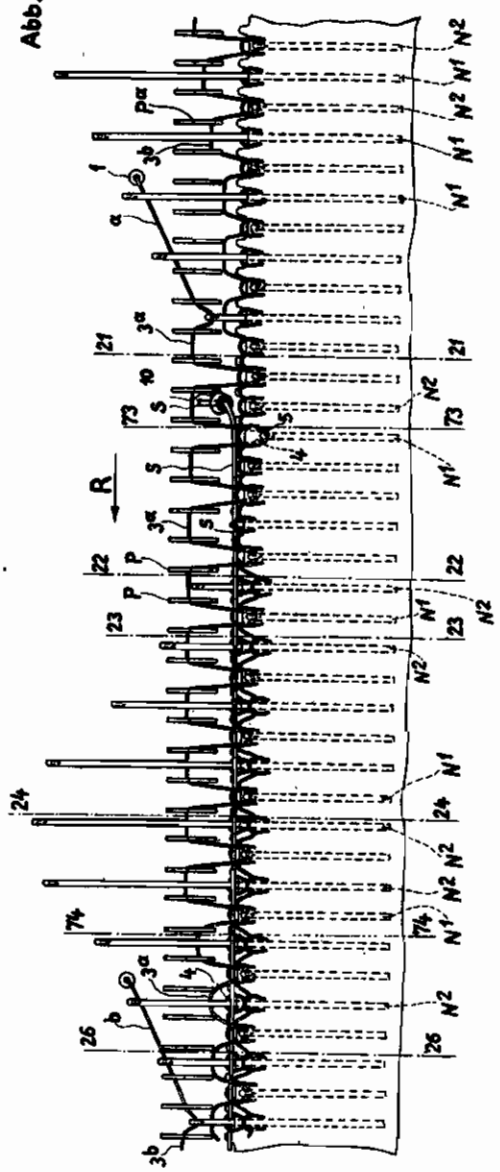

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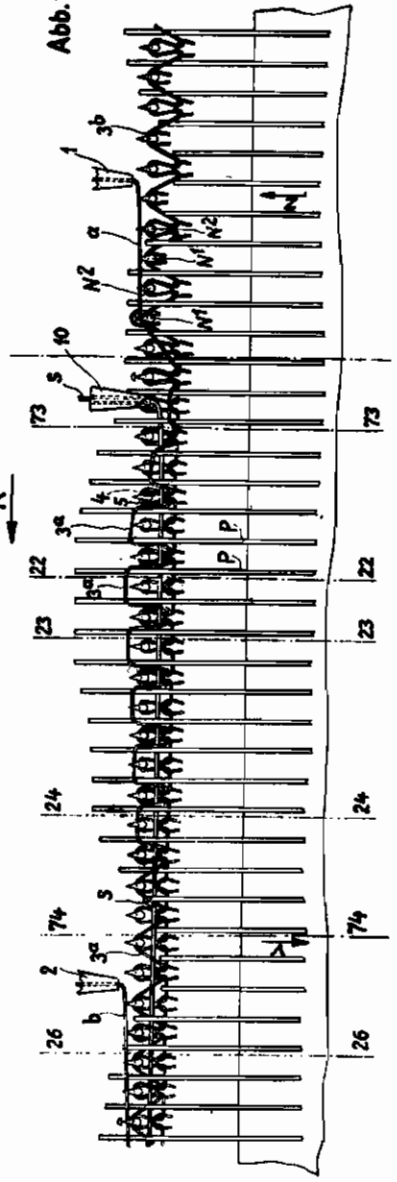

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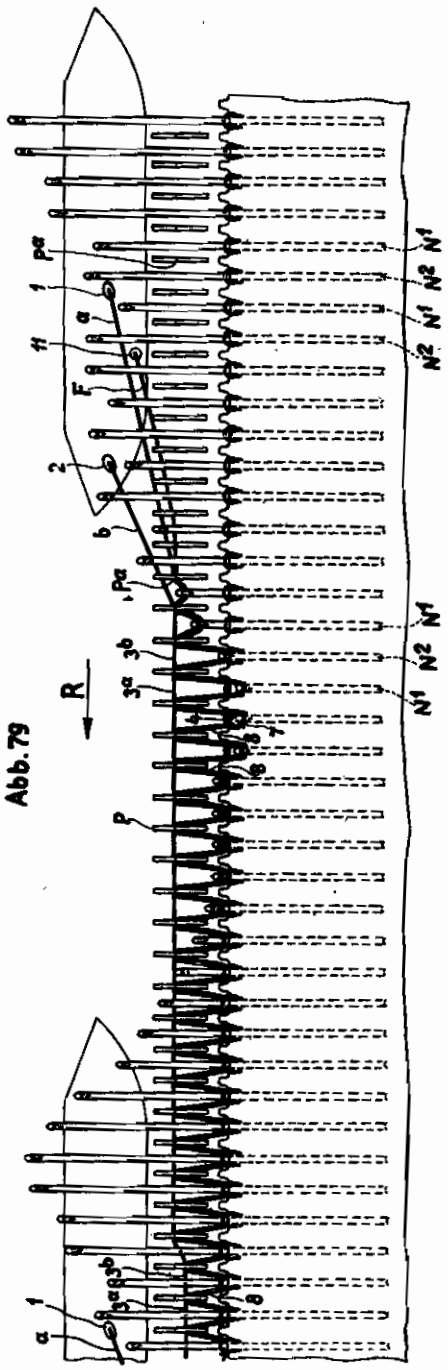

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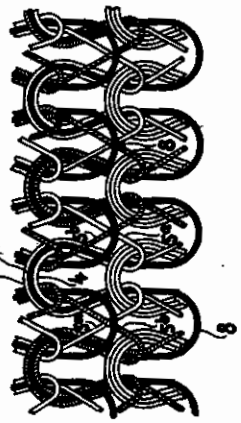

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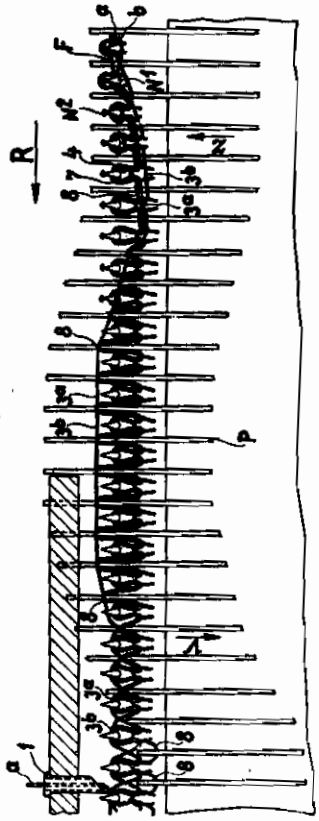

Abb. 80

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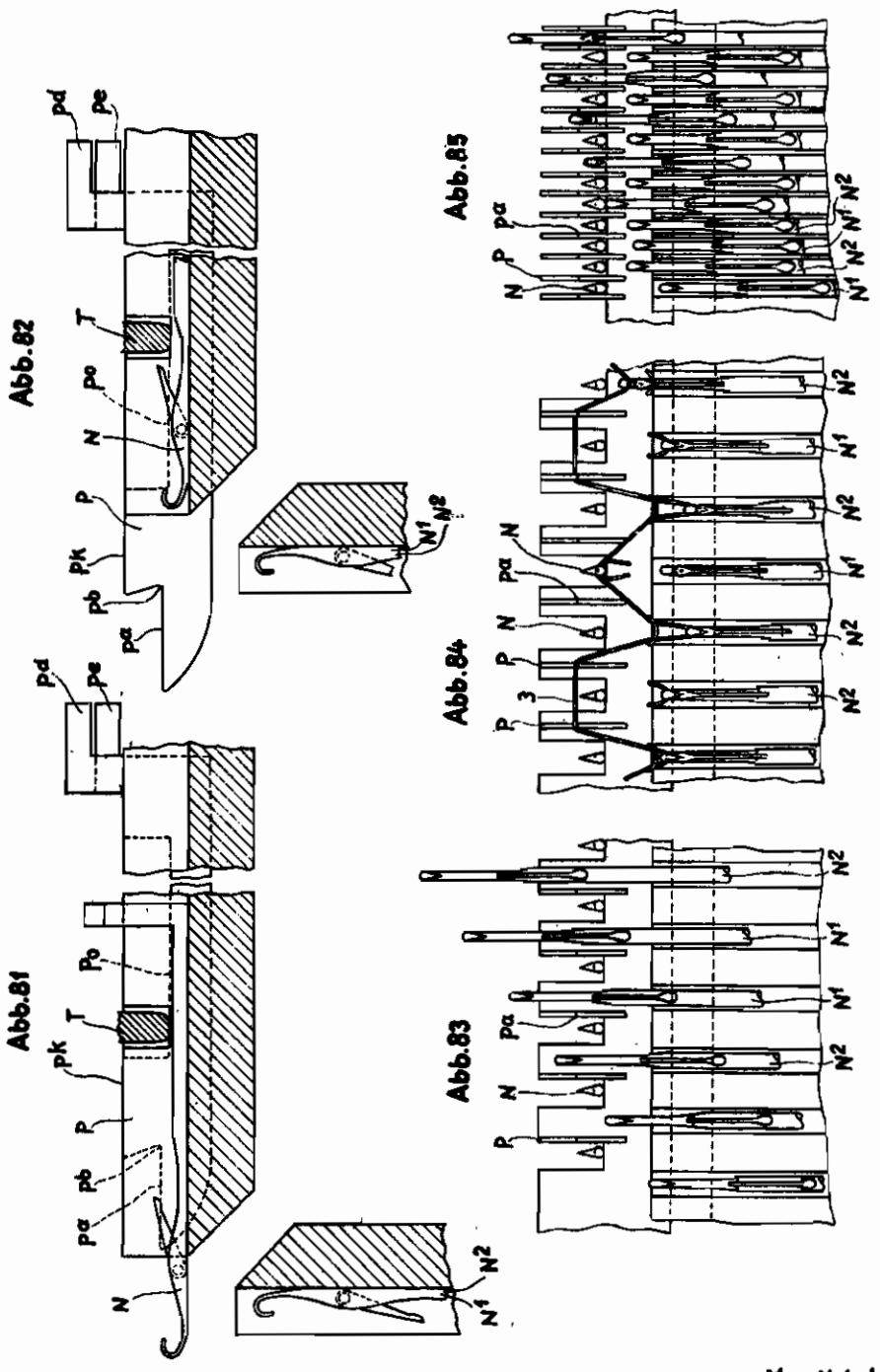

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25 Sheets-Sheet 25

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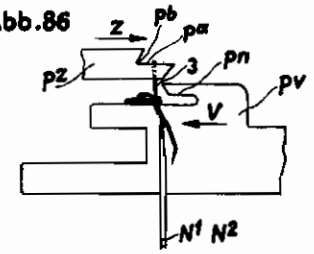

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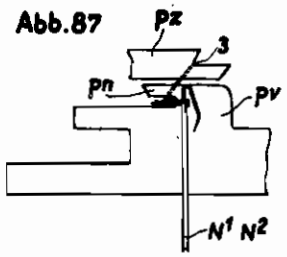

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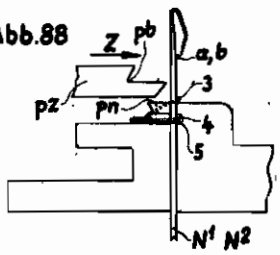

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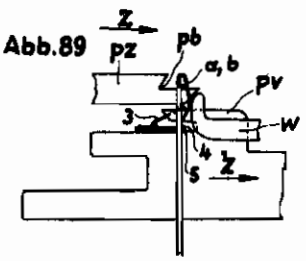

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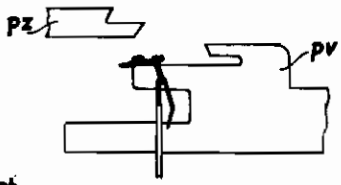

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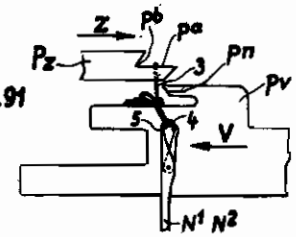

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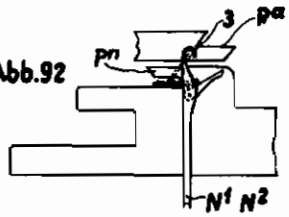

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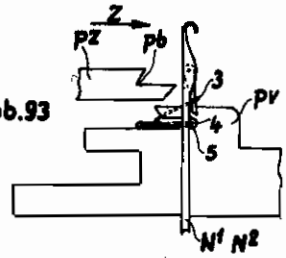

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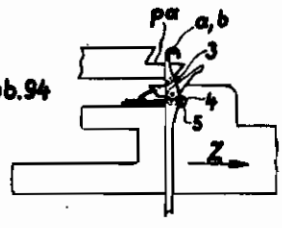

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ALIEN PROPERTY CUSTODIAN

KNITTING MACHINES AND METHOD OF OPERATING SAME FOR KNITTING FABRICS

Max Nebel, Chemnitz, Germany; vested in the Alien Property Custodian

Application filed September 16, 1937

This invention relates to knit goods and a method and device for producing same.

The two main groups of looped fabric, viz. warp goods and hosiery in the widest sense of the term, are well known. Warp goods afford the advantage of great changeability in the manner of connection and can be made extraordinarily close. Besides, it is extremely elastic and ladder-proof, though not so extensible as hosiery. This great transverse extensibility and elasticity so much desired in knit goods cannot be attained in warp goods to the desired extent, since the thread runs not in the direction of the courses as in hosiery but in the direction of the weals, or at least as in traverse warp goods, at an angle to the direction of the weals that is smaller than a right angle. This course of the thread causes undesirable extensibility in the direction of the weals, i. e. in the longitudinal direction of the goods. Furthermore, the production of warp goods involves numerous additional operations which have to be carried out before the actual knitting and which naturally render the finished goods more expensive. Warp goods, moreover, cannot be made regularly with firm edges and are always cut.

Hosiery, on the other hand, does not possess the same changeability as to connection and cannot be made as close as warp goods. The invention aims at combining the chief advantages of both kinds of goods in a new fabric, in which for this purpose the thread extends as in hosiery in the transverse direction of the goods, i. e. in the direction of the courses, to attain the high degree of extensibility, ladder-proofness and other advantageous properties of hosiery whilst the great elasticity, ladder-proofness and other good properties of warp goods are obtained by employing as in warp goods instead of sinker loops thread crossings or, so to speak, mesh shanks which extend from one needle loop of a course to the needle loop of a following course. It has been attempted already to obtain similar connections for hosiery goods as are found in warp goods, but in such instances only mesh shanks or meshes have been tied into the sinker loops of the following course.

According to the invention, needle loops of ordinary length and longer needle loops, or ordinary needle loops alone or long needle loops alone, are present in every course or in certain courses, and the long needle loops in the same weal or in a weal laterally arranged therefrom in the following course are formed together with a needle loop of ordinary length or alone into a needle loop, whilst one of the two shanks of the longer needle loop is tied only into one of the needle loops preceding the needle loop of ordinary length.

For producing the hosiery according to the invention the procedure is further such that the mesh portions disposed between and above the needle loops are worked longer than usual and than the top loop portions of the meshes, so that during looping in a following course these mesh portions can be drawn through the needle loops of the course in which these mesh portions are formed or drawn through the needle loops of a following course and in the next course can be made into needle loops in the same weal or in a weal arranged laterally therefrom. The needle loops that are longer than usual may be formed into a needle loop either alone or together with the ordinary needle loop of the course concerned. The mesh portions located between the needle loops are worked in the width over one or more divisions.

By way of example, different connections of the goods according to the invention and several modes of application of methods of producing such goods are illustrated in the accompanying drawing, in which

Figures 1 to 10 each show a special connection of the goods;

Fig. 11 shows plated goods according to the invention;

Figs. 12 and 13 each show goods with tied-in wefts;

Figs. 14 and 15 show hosiery of known type to explain the development of the loop connection in the goods according to the invention;

Fig. 16 shows the fundamental principle of loop connection in goods according to the invention.

In the following figures which show machines or parts thereof for the application of the various methods the row of sinkers and needles, in so far as circular knitting machines are concerned, is shown rectilinearly and not circularly or in the form of an arc in both the top and front views for clearness' sake. The front view is taken in the direction of the back of the needles, i. e. in circular knitters from inside the needle cylinder. All following front views and top views show a complete looping process from beginning to end and up to the beginning of the next looping process.

Figs. 17 and 18 are, respectively, a front and top view of a section of the needle and sinker plate of a circular knitter for producing goods according to the invention, the sinkers moving in the direction of the back of the needles and both partial courses being formed during a looping operation;

Figs. 19 to 26 are side views of certain needle and sinker positions of sections on the lines 19—19, 20—20, 21—21, 22—22, 23—23, 24—24, 25—25 and 26—26 in Figs. 17 and 18 and also in some figures named below, which illustrate other methods;

Figs. 27 and 35 are front views of a method applied to circular knitters, wherein the sinkers

are moved toward the needle breast or bulging portion of the needle shank;

Figs. 28 to 34 are side views of certain needle and sinker positions and of thread positions of sections taken on the lines **28—28, 29—29, 30—30, 31—31, 32—32, 33—33** and **34—34** in Fig. 27.

Fig. 36 shows the application of a method in a circular knitter, shown in front view, in which the sinkers move in the direction of the back of the needles and both partial courses are formed during one looping process;

Figs. 37 to 40 are sectional side views on the lines **37—37, 38—38, 39—39** and **40—40** in Fig. 36;

Fig. 41 is a front view of a circular knitter showing a method according to which the sinkers move toward the needle backs and both courses are formed during one looping process;

Fig. 42 is a front view of a circular knitter and shows another application of a method according to the invention, in which the sinkers move toward the needle backs and both partial courses are also formed during a looping process;

Figs. 43–44 are sectional side views on the lines **43—43** and **44—44** in Figs. 42 and 43;

Figs. 45 and 46 and 47 and 48 are, respectively, front and top views showing the application of a method, in which both partial courses are formed in two looping operations;

Figs. 49 to 51 are sectional side views of certain needle and sinker positions according to Figs. 45 to 48 on the lines **49—49, 50—50** and **51—51** of these figures and of some others which show other methods;

Fig. 51^a is a side view of a special thread position to insure correct needle position for the different methods to be explained below, this needle position being referred to as "catch position;"

Figs. 52 and 52^a and 53 and 53^a show the application of one of the methods according to the invention to a flat or straight bar knitting machine, in which the sinkers move toward the needle backs. Figs. 52 and 52^a show looping in one working direction and Figs. 53 and 53^a in the other, only one partial course being formed at each looping.

Figs. 54 to 57 are side views of needle and sinker positions and thread positions according to another method;

Figs. 58 and 59 are, respectively, a front and top view of the application of another method according to which both partial courses are formed in one looping operation and the sinkers are moved against the needle backs;

Fig. 59*a* is a sectional side view of Figs. 58 and 59 and the following Figs. 60 and 62 on the lines $59^a—59^a$, of Figs. 58 and 59 and of Figs. 60 and 61;

Figs. 60 and 61 are, respectively, a front and top view of the application of another method;

Figs. 62 and 63 each show a pattern wheel;

Fig. 64 shows a drive for a pattern wheel;

Fig. 65 shows a special operating position of the needle relative to a sinker during reverse plating of goods according to the invention;

Fig. 66 is a plan on the line $66^a—66^a$, of Fig. 65;

Figs. 67 and 68 are, respectively, a front and top view of the application of a method, in which the sinkers move toward the needle breast, only one partial course being formed during a looping process;

Figs. 69 and 70 are sectional side views on the lines **69—69** and **70—70** of Figs. 67 and 68;

Figs. 71 and 72 are, respectively, a front and top view of the application of a method according to which both partial courses are formed during one looping operation;

Figs. 73 and 74 are sectional side views on the lines **73—73** and **74—74** of Figs. 71, 72 and the following Figures 75 and 76;

Figs. 75 and 76 are, respectively, a front and top view of the application of a method according to which only one partial course is formed during each looping operation;

Fig. 77 is a front view of the application of a method, in which nooses are laterally hung over and formed alone into a needle loop and only one partial course is formed at each looping operation;

Fig. 78 shows goods according to the invention provided with plush loops;

Figs. 79 and 80 are, respectively, a front and top view of the application of a method for producing loop-plush goods according to Fig. 78, in which both partial courses are formed during a looping operation;

Figs. 81 and 82 are lateral views of two working positions of the needles relative to the sinker in the application of a method to machines having two rows of needles and sinkers in one needle row, which move toward the backs of the needles of the other row;

Figs. 83, 84 and 85 show in front view different possibilities of arranging the sinkers shown in Figs. 81 and 82 in one of the needle rows;

Figs. 86 to 90 are side views showing different working positions of spring needles relative to sinkers one of which moves toward the needle breast and the other toward the needle back;

Figs. 91 to 94 show in side view the same possibilities of the application of a method according to the invention as Figs. 86 to 90, with the difference, however, that latch instead of spring needles are used; and

Fig. 95 is a side view of a position of a spring needle with the sinkers moving toward the needle breast in the application of the method according to the invention.

In view of the possibilities of producing the goods according to the invention described below it is pointed out, in order to better understand the connection provided by the invention, that one proceeds from two ground connections of knit goods. In the first place, there are two threads *a* and *b* (Fig. 14) in a course all loops of which lie in two partial courses on a straight line L—L, and the two threads *a* and *b* are alternately made in needle loops A and B, whilst the sinker loops C are formed half by the thread *a* and half by the thread *b*. In this kind of goods the needle loops of a course always consist of one thread, alternately *a* and *b*, and the thread portions *e* and *d* of the threads *a* and *b*, which have not been formed into loops A and B, are so arranged behind the needle loops A and B, alternately formed of the thread *a* or *b*, as unfinished loops *e* and *d* that every second loop *d* of a course covers the ends of the loops *e* laterally arranged therefrom. This change 1+1 in the formation of the needle loops from one of the threads *a* and *b* and this relative position of the loop portions *d* and *e* occur in every weal.

The other starting connection is shown in Fig. 15. This fabric also consists of two threads *a* and *b*, but all loops A formed of the thread *a* lie on the straight line M—M and all meshes B formed of the thread *b* lie on the line N—N which is positioned parallel to the partial course, i. e. the line M—M, of the loops A.

In the partial courses M—M and N—N both threads *a* and *b* are made into needle loops A and B and into partial loops *e* and *d* in such manner that the parts *d* and *e* do not cover each other and the change in forming loops A and B from threads *a* and *b*, which is present when both partial courses are considered together, does not occur in the weal.

From these two known fundamental connections the goods according to the invention are developed as follows:

The two incomplete loops *e* and *d* are made longer than in the known connections, approximately as long as shown by dots and dashes in Figs. 14 and 15 and designated 3 or 3^a, 3^b in Fig. 16. These longer loops 3 are made in the next course together with a needle loop A or B, which as needle loop of ordinary length is subsequently designated 4, into a long needle loop 5.

In the initial connection shown in Fig. 14, wherein the partial courses formed of the loops A and B lie on a line L—L, several connections according to the inventions are represented by a thread in sold black. One loop 5 of the black thread is in the weal together with the needle loop A or 4 of the following course made into the needle loop 5 above which it would lie as thread member *d* or *e* in the initial connection. This manner of connecting is characterized in the following description by the words, "that the longer loops 3 in the same weal are made in the following course or next but one into long needle loops 5 together with the needle loop 4 of ordinary length".

The other mesh 5 of black thread in Fig. 14 is not worked in the same weal into a needle loop in the next course but in a weal that is laterally arranged therefrom. This lateral hanging over of the long loops 5 naturally requires somewhat more thread than does the long needle loop 5 which is worked into a needle loop in the same weal in the next course, as indicated by the unfinished loop 3^d, shown in dots and dashes, of the laterally hung over needle loop 5, which is somewhat longer than the other member 3. In a special kind of the goods according to the invention the long loop members 3 can be made also alone into long needle loops 5 in a following course.

In the initial connection shown in Fig. 15, wherein the two partial courses formed of the loops A or B lie on two straight lines M—M and N—N, the connections according to the invention are also indicated by two threads *a* and *b* in solid black. The new connection shown in Fig. 14 by the black thread can be made also in the goods shown in Fig. 15, and vice versa.

Fig. 15 shows the loop *e* made of the black thread *b*, the loop *e* or 3 being longer than in the initial connection and in the adjacent weal of the meshes A worked in the following partial course into the longer needle loop 5 together with the mesh A. For better distinction this loop 5 is designated 5^x. In the other black partial course of thread *a*, whose loop *d* in the initial connection is formed into a longer loop 3, this loop 3 is made in another direction than loop 5^x in the adjacent weal B into the long needle loop 5^y together with the mesh B of the following partial course.

The long needle loop 5^z also shown in Fig. 15 and made of the black thread *a* is in the following partial course and in the weal disposed laterally of the initial weal B made into a loop with the mesh B, subsequently referred to as 4.

In the ground connections described and shown in Figs. 14 and 15 the mesh shanks or loop portions producing crossings according to the invention are formed of the thread portion which extends from the long needle loop 5 to its associated ordinary needle loop 4, the needle loops made of the thread *a* being designated 5*a* and those made of thread *b*, 5^b. As indicated in Fig. 15, from the ordinary loops of a course formed of the threads *a* or *b* loop shanks 5^a or 5^b extend as portions of the long needle loops made of the same thread to a following course.

These various ways of laying thread and making connections while starting from different initial connections may be combined at will. Examples of such combinations will be described below, and it is pointed out that for each connection described an equivalent warp fabric connection is available, with the difference, however, that in the examples of fabric according to the invention the thread extends in the transverse direction of the goods.

The general procedure is such that the thread portions lying between the needle loops and worked longer than usual are drawn during looping of a following course through the needle loops of the course in which the loops are formed or through the needle loops of a following course and then formed in the next course, in the same weal or one laterally arranged therefrom, into needle loops.

The loop formation shown in Fig. 14 is produced as follows starting from Fig. 16:

1. *Looping step.*—The thread *a* of needles N^1 is placed behind the needle head and under the needle head of needles N^2, whereupon the thread *b* is placed behind the head of needles N^2 and under the head of needles N^1.

Both threads are sunk to form longer loop portions 3 and needle loops of ordinary length (Fig. 14). As each thread is sunk from every other needle, the loop portions 3 have the width of twice the needle division. The loop portions 3 are drawn out so much longer than usual that enough thread is available for finishing the long needle loops 5 in the next course, which are twice as long or even longer than ordinary needle loops 4. The various loops formed of the threads *a* and *b* are designated 3^a and 3^b in Fig. 16. The loops 3, 3^a, 3^b are after the sinking step when the needles ascend again brought over and beyond the needle head under the hook, which is made possible by the fact that the loops 3^a and 3^b each extend over a division in width.

Hanging over according to Fig. 16 is as follows: Loops 3^a over needles N^1; loops 3^b over needles N^2.

The portion 2 which is drawn from the long drawn out loop through the old mesh 4, 5 becomes the ordinary loop 4 whilst the other portion which owing to the higher sinking point holds more thread forms the long loop 3. There are two sinking edges, the ordinary one and a second one located above the ordinary edge, the higher edge serving for sinking and the ordinary edge for finishing and knocking over.

After the hanging over step the needles N^1 and N^2 ascend farther into pressing position. This pressing step is carried out as follows:

The meshes 4 and 5 which were on the needles already before hanging over took place are pressed off as usual, i. e. these old meshes are placed below the latch on the needle shank to be knocked over during the next looping operation by sliding during the following sinking step over the

closed latch and being thrown off from the needles. The loops **3** that have been hung over are not pressed and remain below the hook on the latch until the next sinking operation.

2nd loop formation.—This next sinking operation starts by placing the thread *a* from the needles N^2 under the needle head N^1. The thread *b* is placed from the needles N^1 under the needle head N^2.

The loops **3** drawn from the threads *a* and *b* are during the sinking operation together with the loops **3** of the first sinking operation that are not pressed off (first looping step) under the hook and, together with the new needle loops **2** which are made into ordinary loops **4**, are worked into long needle loops **5**.

It follows from both looping steps that from the ordinary loops **4** of a course, formed of the same thread *a* or *b*, loop portions or shanks 5^a or 5^b extend to the long needle loops **5** of the following course and connect needle loops of one course with the needle of a following course instead of the ordinary sinker loops in goods in which the needle loops of a course are connected by sinker loops. In this way, instead of a sinker loop cross threads are formed as seen in the goods shown in Fig. 16.

3rd looping step.—Then follows the next sinking operation, during which the thread *a* is placed behind the head of the needle N^2 and under the head of needles N^1 whilst the thread *b* is placed behind the head of the needle N^1 and under the head of the needles N^2.

4th looping step.—During the fourth sinking operation the thread *a* is placed behind the head of the needles N^1 and under the head of the needles N^2, whilst the thread *b* is placed behind the head of the needles N^2 and under the head of the needles N^1.

The 5th looping step resembles the preceding one and the sixth step is similar to the second.

This process yields a fabric in which the loops are positioned as in the basic connection shown in Fig. 14.

To produce goods showing the connection according to Fig. 15 one proceeds as follows:

1. Sinking operation as described for the first looping step; 2nd sinking operation as in the second looping step; then again as in the first sinking operation, followed by the second sinking operation, and so on.

In the goods shown in Figs. 1 and 2, each loop comprises two threads *a* and *b* and a long and a short mesh, the long mesh **5** being worked together with the short mesh **4** of the next course to form a needle loop.

In the fabric according to Fig. 1 all loops lie on a straight line **2**—**2** in accordance with the fundamental connection shown in Fig. 14, in the manner of ordinary knit goods, whilst in Fig. 2 the loops lie on two straight lines N—N and M—M according to the fundamental connection shown in Fig. 15.

In both fabrics instead of sinker loops thread crossings are produced and thus both goods externally resemble the diagram of mesh formation of the known traverse warp goods.

The method employed is indicated in Figs. 17 to 26.

There are two needle groups N^1 and N^2 guided in two cams, and the needles N^1 are longer than the needles N^2. The heel of the long needles N^1 is designated N^{1x} and that of the shorter needles N^2, N^{2x}. As indicated in Figs. 17 and 18 and the side views **19**—**26**, particularly in Figs. 19, 20 and 21, both needle groups are moved differently. At each sinking operation two threads *a* and *b* issuing from the thread guides **1** and **2** are worked. The needles of group N^1 move below the thread guide **1** and past it and ascend so high that their head moves above and past the guide **2**. To insure reliable placing of the threads behind the needle heads the latter preferably are bent somewhat toward the thread guide, as indicated in Fig. 19. Through the needle motion mentioned the thread *a* is brought behind the heads of the needles N^1 and the thread *b* under the hook N^1. The needles of the group N^2 move with their heads above and past the thread guide **1** and then descend to pass below the thread guide **2**. In this way, the thread *a* is brought under the needle hook N^2 and the thread *b* behind the needle head N^2. Out of their elevated position (Fig. 24, pressing position) the needles of both groups, before passing into their operating position relative to the thread guides as described, are preferably moved down a certain extent, so that when the sinkers leave the needle row (Fig. 25) the loop **3** lying on the open latch cannot slip off from the latch, as it would then hang upon the needle shank without the necessary distance from the old mesh **4**, **5**. Furthermore, the needle heads must pass as closely as possible above and below the thread outlet of the guides, so that the latch always remain as separating member between the loops **3** and the old meshes **4**, **5**, as shown in Figs. **19** and **28**. The sinkers P, moved by cams of known type, enter in the direction Z between the two thread guides **1** and **2** (Fig. 18) and pass toward the needle back through the needle row and under the threads *a* and *b* to such an extent that, as indicated in Fig. 19, the threads during the sinking of both needle groups N^1, N^2 are placed on the sinking edge P^a of the sinkers P. This edge P^a is arranged so much higher than usual (Fig. 17) that the loop is drawn out as required to give the longer loops between the needle loops **4** so much more thread than usual to enable them to be worked in the next course into the loop **5**. The loop **3** will then be so positioned that the loop 3^a of the thread *a* lies above the two sinkers P between the needles N^1 and above the needles N^2 and the thread 3^b above the sinkers between the needles N^2 and above the needles N^1 (Figs. 17 and 18). During this sinking of the loops on the edge P^a finishing of the loops on the ordinary sinking edge K is effected, which lies underneath the lower sinker edge P^c. The goods hanging on the needles lie on the edge K.

The sinking depth can be adjusted by vertically adjusting the sinker bar or by sinking the needles correspondingly or, which is particularly advantageous, by varying the position of the two loop-forming tools, sinkers and needles, in such manner that the needles below the ordinary sinking edge K (Fig. 21) go down lower than usual and the sinking point for the loop portions is raised by raising the sinkers P and thereby their edge P^a.

After sinking of the long loops, as indicated in Figs. 20, 17, 18 and 21, the sinkers P prior to the ascent of the needles move farther in the direction Z toward the needle backs until the long unfinished loops **3** which are each carried by two sinkers, are brought forward by the throat P^b to such an extent (Fig. 22) that the ascending needle passes through the loop (Fig. 23). The long loop is thus transferred to the needle (Fig. 23) and lies below the hook. After this transfer the sinker moves back somewhat in the direction V

to permit the loop to lie within range of the needle hook (Figs. 23 and 18).

To permit the placing of the hung over loop **3** under the hook care must be taken that the latch of the needle is open already when it moves out of the sinking position (Figs. 21 and 29) into hanging over position (Figs. 22 and 30). This opening of the latch can be effected by known means, for instance by using a latch opening brush in machines in which the sinkers are moved toward the needle back or by employing latch needles in which the latch guide slot is not slotted toward the needle back, so that the latch when a loop passes over it is elastically held in closed position and opens when no pressure is exerted upon it any more.

The most usual procedure is to have the latch opened by the old loop when the needle is moved up after sinking, and this method can be used also in connection with the invention if the latch is so short (Figs. 91 and 92) that it will be opened by the old mesh **4**, **5** already before the needle head during motion of the needle from sinking position (Fig. 91) into hanging over position (Fig. 92) passes through the loops **3** pushed in front of the head on the sinkers P.

When the needle moves into highest position, i. e. pressing position (Figs. 17, 18 and 24), the sinker is still in the needle row to such an extent that the long loop still lies on the edge P^a and on the open latch and the old meshes **4**, **5** are separated by the lower edge P^c from the hung over loops **3**, so that during pressing when the old mesh slides from the open latch owing to the ascent of the needle onto the needle stem the new loop **3** is not placed below the opened latch on the needle shank. This pressing position is the highest needle position from which it moves down again whilst the sinker passes out of the needle row in the direction V (Figs. 17, 18 and 25). When the sinker separating the old and new loops is moved out of the needles, the latch takes care of separating the old from the new loop even if at the beginning of a new sinking operation the sinker moves again between the needles (Fig. 26). To prevent damaging or displacement of the loops **3** by the sinker the lower edge P^c of the sinker P is bevelled at the free end of the sinker in such manner that the lower edge P^c forms a point with the upper edge P^a.

The next sinking operation is initiated as the first one with the difference, however, that the thread *a* is brought under the head of the needles of group N^1 and behind the head of the needles of group N^2, whilst the thread *b* is brought under the head of the needles of group N^2 and behind the head of the needles of group N^1 (Fig. 19). During the sinking operation the loop **3** lying on the open latch together with the freshly sunk needle loops is drawn through the mesh **4**, **5** (which is still on the needles, Figs. 20 and 21) of the preceding course and formed into a new loop **3**.

The old mesh **4**, **5** is thrown off over the needle head, as indicated in Figs. 20 and 21. The loop **3** is then hung over again so as to lie in front of the head below the hook (Figs. 22, 23), and in this way the fabric shown in Fig. 1 is produced.

Production of the goods shown in Fig. 2 involves the same operations, the only difference being that the motions of the needle groups N^1, N^2 are not changed from one sinking operation to another. It is therefore essential that as in the method of production shown in Fig. 1 and described above two threads are alternately brought in front of and behind the heads of the needles of both needle groups N^1 and N^2 during a sinking operation and, further, that the needles of the group in which the thread issuing in working direction is to be brought behind the needle head rapidly ascend directly behind the first thread guide to insure safe placing of the thread, since the thread issues in a curve toward the needle which thus has to move up behind this thread curve, as shown in Figs. 17 and 18, wherein one needle path is designated by dotted lines and the other one by dash and dot lines. The needle group N^1 places the thread *a* and sinks the thread *b*, whilst the needle group N^2 places the thread *b* and sinks the thread *a*.

The needle designated N^{1z} moves directly behind the thread guide **1** whose thread *a* is to pass behind the heads of the needles N^1 and rapidly passes into the position of the needle N^{1y} (Fig. 17). Fig. 18 clearly shows how the thread *a* issues in a curve from the guide *a*, so that the needles N^{1z} can safely push up behind.

The group N^2 which has to place the thread *b* passes after placing the thread *a* under the needle head gradually down into sinking position and thus below the thread outlet of the guide **2** and beyond the latter (dotted line), so that the thread *b*, which is taken by the ascended needle of the other group N^1 under the hook, cannot be caught by these needles N^2 and is thus placed behind the needle head.

To bring the thread outlet as closely as possible to the needles the thread tube is bevelled in known manner towards the operating direction R, Figs. 17 and 18, whereby also the curvelike issue of the thread from the guide is facilitated.

The application of the method described does not depend upon the motion of the sinkers in the direction of the needle backs. The better known and more customary motion of the sinkers in the direction of the needle breast is suited also.

The other methods to be described below may also be carried out on such machines, except goods with laterally overhung connections and goods with wefts.

Figs. 27 to 35 show the most important working positions. The novelty is that three sinkers are guided in one cut instead of one or two which move between the needles. Every third set of sinkers comprises two sinkers of novel shape, hook sinkers **15** (Figs. 35 and 27), which are disposed between two covering sinkers **16** whose noses 16^a cover the hook 15^a of the sinkers **15**. The upper edge 16^c of both covering sinkers **16** is on a level with the upper edge 15^c of the sinkers **15**. The hook 15^a projects from this edge and serves for drawing the floating thread portions of each needle, which extend for instance from one needle to the next but one, forward beyond this needle when it is in sinking position (Figs. 29 and 30) to such an extent that during ascent of the needle the floating portion is positioned on the side of the needle breast and is brought under the needle hook. The covering sinkers serve for covering the hooks when the sinkers move out of the needle division, so that the floating thread portion is lifted without trouble on the upper edge of the nose 16^a rising up to 16^b over and beyond the hook 15^a. Both sinkers **16** always act jointly. The sinkers **15** are independently movable and are driven in known manner by special cams.

The mode of operation is as follows: Two needle groups N^1 and N^2 are working again which alternately place the thread *a* or *b* under the needle hook or behind the needle head in the same manner as described with reference to the method for producing goods as shown in Figs. 1 and 2.

Fig. 28 shows in section on the line 26—26 of Fig. 27 sinkers in inoperative position and the laying of the thread *a* or *b* under or behind the hook, Fig. 28 showing that the thread *a* has been brought under the hook of the needle N^1 and behind the head of the needle N^2. The curve-like issue of the thread from the guide 1, whereby the placing of the thread behind the head of needle N^2 is made possible, is not indicated in this figure. The position of the thread guide and the course of the thread are the same as in the previously described method (Fig. 18). On the path limited by the thread guides 1 and 2, Fig. 27, all three sinkers jointly move through the division and below the thread *a*, so that also the subsequently laid thread *b* like thread *a* passes over the sinker backs 15c and 16c behind the hook 15a or hook covering nose 16a, but knocking over position is not reached. When the needle sinks (Figs. 27 and 29), the new loops are sunk longer than usual. Whilst the needle begins to pass out of the sinking position into upper position (Fig. 30), the covering sinkers move in the direction Z into knocking over position. During this motion of the covering sinkers the hook sinker 15 moves alone out of the needles in the direction V and draws back the loops lying over one needle and the backs of two sets of sinkers 15, 16, 16 far enough that the thread is placed on the breast side of the ascending needle. When the needle has risen so high that the loop under the hook is positioned on the needle breast side, the hook sinker moves in the direction Z until the loops leave the hooks (Figs. 31 and 27). All three sinkers 15, 16, 16 remain in the position shown in Figs. 31 and 27 during the locking in operation. When the needles ascend farther into pressing position, the covering sinkers move into the position shown in Figs. 32 and 27, so that the hook 15a is covered by the nose 16a and the loop 3 is disposed along the incline 16b under the hook 15a, as shown in front view in Figs. 35 and 27. During the pressing operation the covering noses 16a separate therefore the old meshes 4, 5 on the shank of the needle from the long transferred loop 3, so that the meshes 4, 5 are kept below the open latch on the needle shank and the loop 3 remains lying on the open latch. (Figs. 32 and 27).

When the needles descend after pressing, all three sinkers 15, 18, 16 jointly move out of the needle row in the direction V. The loop 3 is thus absolutely freed from the sinkers and hangs only on the needle below the hook while lying on the open latch (Figs. 33 and 27), so that, as shown in Fig. 34, when the descent of the needle begins again and the operations according to Figs. 28 and 27 start again, the latch closes and the loop is worked into a mesh together with the new thread to be sunk.

The covering nose 16a has an inclined edge 16c extending from the point downwardly to prevent during advance of the sinkers into operating position the loops 3 from being damaged or displaced. The change in operation of the needle groups relative to the thread guides is the same as described before, and the method is like the previously described one and merely employs new means like the new sinkers and novel relative motions of the sinkers and needles.

The goods to be made are restricted to those in which the long loops are worked into needle loops either alone in the same well and in the next course or together with the shorter loops of this course. Weft fabric, too, cannot be made, since the sinkers moving toward the needle breast prevent the insertion of a weft thread.

According to the method just described two needle groups N^1 and N^2 are so operated that both groups during one and the same sinking operation simultaneously work both threads *a* and *b* alternately into ordinary and longer loops and hang them over. In the production of all kinds of goods according to the invention this method may be altered so that at one system only one needle group N^1 or N^2 sinks only one thread to form ordinary and longer loops and hangs them over after this sinking operation, or hangs over only after the sinking operation following this first one, whilst the other needle groups, i. e. the needles in between, are not participating in the sinking motion and the old meshes remain on these needles. This group works only at the next system, so that at the first system needle group N^1 works and N^2 is inoperative, second system needle group N^2 works and N^1 is inoperative, and at the third system needle group N^1 operates and N^2 is eliminated, etc.

The change may also be such that at the first system group N^1 operates and N^2 is eliminated; at the second system, group N^2 operates and N^1 is eliminated; at the third system group N^2 operates and group N^1 is eliminated; at the fourth system group N^1 operates and group N^2 is eliminated; at the fifth system group N^1 operates and N^2 is eliminated; at the sixth system group N^2 operates and N^1 is eliminated, etc.

At uniform change of the working needle groups in the sequence N^1, N2, N^1, etc. (shown in Figs. 75 and 76 without working in a weft) the needles N^1 first work in the operating direction R, that is, in the drawing, from right to left, the meshes 4 and the long loops 3a from the thread *a*, and the needles N^2 move in the meantime through this system, the relative position of the sinkers and needles being shown in Fig. 21. The long loops between the needles N^1, which hang on two sinkers P, extend over the needles N^2 disposed between every two needles N^1. The needles N^2 pass from the position shown in Fig. 21 gradually up into hanging over position, the relative position of the sinkers and needles being shown in Figs. 22, 23, 75 and 76, when the long loops 3a, as indicated in Fig. 23, are transferred to the needles N^2. Then follows the pressing position at which the relative position of the sinkers and needles will be like that shown in Fig. 24, when the previously transferred loops 3a remain on the open latches and the old meshes 4, 5 are placed under the latch, i. e. are pressed off. After pressing the needles N^2 pass into sinking position, Figs. 75 and 76, and the transferred loops 3a are kept separate from the old mesh 4, 5 by the latch, as indicated in Figs. 25 and 26. The thread *b* is drawn out into ordinary loops and longer loops 3b. During this sinking motion of the needles N^2 the needles N^1 move through this system at the elevated position shown in Fig. 21. This position has been taken by the needles N^1 immediately after their sinking operation in the preceding system. During sinking of the needles N^2 the long loops lie between the needles N^2 over and beyond a needle N^1. When the needles N^1 move into pressing position, hanging over of the long loops 3b and working out with the newly sunk loops occur on the needles N^1. The first-described operation of the needles N^1 is now repeated, so that the group N^1 alternates in the manner described with the group

N^2, whereupon N^1 alternates with N^2, and so forth, as seen in Figs. 75 and 76.

At each system needle groups can be sunk and meshes formed and plated goods in known manner be worked only in such manner that, as indicated in Figs. 45, 46, 47 and 48, the thread guide 1, shown in dotted lines, lays the ground thread *a* and the thread *b* issuing from the guide 2 is laid as plating thread.

When the groups change in the sequence N^1, N^2, N^2, N^1, N^1, N^2, N^2, N^1, etc., the mode of operation of the loop-forming tools differs in so far as each needle group successively carries out two sinking operations.

This method is shown in Figs. 45 to 51. On all needles N^1 and N^2 the long loops 3^a and 3^b of the partial courses formed of the threads *a* and *b* are hung over before the sinking operation to be described begins. The needle N^1 gets the thread *a* from the guide 2, sinks it to form ordinary and long loops, whilst the needle N^2 is inoperative (position as shown in Figs. 20, 21) and works the previously transferred loops 3^a during sinking of the mesh 4 into the loop 5, as indicated in Figs. 20, 21. The newly sunk loops 3^a are not transferred by the sinkers P (Fig. 46) to the needles N^2, when the latter move up after the sinking of the needles N^1, because the needles N^2 still hold the old transferred loop 3^a together with the old mesh 4, 5 (Fig. 50). To work always only one long loop, the long loop is not transferred over the needle head according to Fig. 22, but, as indicated in Figs. 50 and 46, the sinkers remain in sinking position until after the next sinking operation (Fig. 48), so that the needle N^2 goes up in front of the loops 3^a on the sinkers P, though not as high as required for pressing, but only as high as shown in Fig. 45, so that the old transferred loops do not lie below the open latch on the old mesh (Fig. 50). During the next sinking operation (Figs. 47 and 48) the needles N^2 work the thread *b* issuing from the guide 2 into loops 4 and long loops 3^b and the old loops 3^b into loop 5. During working of the needles N^2 the needles N^1 remain in the low position shown in Fig. 49 and on line 49—49 of Fig. 45. After the needles N^2 have finished their work (Figs. 47 and 48) all old loops on the needles together with the newly sunk ordinary loops 4 of the threads *a* and *b* are worked by the needles N^1 and N^2 into loops 5. The new loops 3^b worked in the preceding system by the needles N^2 and the new loops 3^a still earlier formed by the needles N^1, which are not transferred as described (Figs. 50 and 46), are, as indicated in Figs. 47 and 48, prior to the third sinking operation like the loops found over all needles N^1, N^2 brought into pressing position before all needles N^1 and N^2 go up, the position of the tools being shown in Figs. 22 to 24. From the pressing position all needles move out again, and the needles N^2 which are going to carry out a sinking operation move into sinking position and work the thread *a* (Fig. 47) and otherwise repeat the operations described. The other needles N^1 move down before the thread guide into catch position (Fig. 51, line 51—51 in Fig. 47) where the needle is so positioned that the loop 3^a lies under the needle head and the closed latch and the old mesh 4, 5 on the closed latch. The needle should not be so low that the old mesh can be thrown off over the needle head, since during re-ascending the old meshes, as shown in Fig. 50, lie again under the latch and the loop on the open latch.

This position is occupied by the needles which after all loops have been hung over on all needles are eliminated from the next sinking operation.

Figs. 67 and 68 show another mode of operation.

In the method described just now the long loop is sunk behind or over the needles and after sinking during ascension of the needles brought before the needles by the sinkers and transferred to them. It is further possible, as shown in Figs. 67 and 68, 69 and 70, to sink long loops and to work them during the next sinking operation together with the new ordinary needle loop into a loop in the following manner. Every other needle N^1 sinks a thread *a* issuing from the guide 1, but during this sinking of the needles N^1 the other needles N^2 do not pass into low or catching position. On the contrary, they pass at such a high position through the sinking point (Figs. 67 and 69) that the long loops 3^a lie already during sinking above the sinker edge P^a on the open latch below the needle head of these non-sinking needles N^2 (Fig. 69). After the pressing operation following this sinking of the needles N^1 press off as usual, because they have no long loops, whilst the needles N^2 with long loops can participate in the pressing motions of the needles N^1, but, as shown in Fig. 70, ascend only so far that the loops 3^a sunk on the upper edge P^a are not placed under the open latch on the needle stem and are separated from the meshes 4, 5 by the sinker nose P^n so that they are not pressed. The sinkers P move in the direction Z under the thread *a* into the division and after pressing, when the needles are in the position shown in Figs. 25 and 67, move out of the division and release the loops 3 (Fig. 68). During the next sinking operation the needles N^2 act like the needles N^1 in the preceding sinking operation and work the thread *b* of the guide 2 into ordinary loops 4 and long loops 3^b above the sinker edge P^a on the open latch and below the head of the non-sinking needles N^1, the long loops 3^a having remained on the needles N^2 from the preceding sinking operation and the ordinary mesh 4 being worked into a long needle loop 5. Pressing takes place as after the preceding sinking operation but with a change in the function of the needle group. This change of function of the group may be effected as in the previously described method. Furthermore, instead of the sinkers shown in Figs. 67 to 70 sinkers of the type shown in Fig. 19 may be used.

The only difference existing between this and the other method is that the long loops sunk by a needle group are not transferred after sinking to the interposed non-sinking needles, but lie in front of the open latch of these needles above the upper edge of the sinker and are therefore already transferred when formed into long loops.

According to these methods and their variations as described goods as shown in Figs. 1 and 2 can be produced which are double-threaded in every needle loop.

Fig. 3 shows a fabric which is only single-threaded in every needle loop, but which otherwise discloses the features shown in Figs. 14 and 15.

In this fabric two superposed courses are formed of two threads *a* and *b*. Each thread is alternately worked into short meshes 4 and long needle loops 5. In contradistinction to Figs. 1 and 2 and the other fabric shown the long loops 5 are formed into needle loops alone and not to-

gether with the short meshes **4**, so that they form a needle loop by themselves.

The portions 5^a of the long loop **5**, which are within range of the short meshes **4**, form a thread crossing which replaces the sinker loop. For this reason no sinker loop is present in the row of the long needle loops.

The method of producing such fabric is shown in Figs. 36 to 40.

There are two needle groups N^1 and N^2 which are moved by different cams. There are further two thread guides **1** and **2** for the threads *a* and *b*. The manner how the two groups N^1 and N^2 get the thread, the manner of sinking, the hanging over of the longer drawn out loops **3** under the needle hook and the pressing of the old meshes and the non-pressing of the hanging loops **3** are as previously described (up to line **37—37** in Fig. 36). The new feature is that the hung over loop **3** which lies under the needle head on the latch while the short mesh **4** lies below the latch (Fig. 37) is drawn during further descent of the needles through the old mesh **4** which closes the latch (Fig. 38) and the old mesh is thrown off, so that the long loop **3** is made alone into a long needle loop **5** without the short mesh in the goods according to Figs. 1 and 2, since during further motion into sinking position (i. e. motion behind the line **37—37**, Fig. 36) no thread is fed. The needle then goes into pressing position (Figs. 40 and 24) and the loop **5** which hangs on the needles alone is placed below the open latch on the needle shank. Only during the following sinking operation thread is obtained again by both needle groups, which is worked into long loops **3** and short meshes **4**, whereupon the next row is sunk without thread feeding by working out the long loops, etc. By working two threads *a* and *b* the double-threaded course *f—f* (Fig. 3) is formed, which consists of the short meshes **4** and the crosses of the portions 5^a and 5^b, whereupon the course *e—e* is formed by threadless sinking and working out of the long loop **5**.

During the sinking with thread getting (to the right of line **37—37**, Fig. 36) the sinkers move relatively to the needles exactly in the same way as in the method described with reference to Figs. 17 and 18. During sinking without thread getting the sinker remains in the position outside the needle row in which it has to be before sinking with thread getting begins, as indicated in Figs. 37 to 39. Fig. 40 shows the beginning of sinking with thread getting after pressing of the loops **5**. The sinker is again in the same needle row.

Fig. 4 shows a fabric in which the sinker weals alternate with a cross weal. Each course and each needle loop is double-threaded (threads *a* and *b*). The long loops **5** form with their shanks 5^a and 5^b toward one side an ordinary sinker loop **6** together with the adjacent short mesh **4** and toward the other side, together with the shank 5^b or 5^a of the adjacent long loop **5**, a crossing.

The method of producing this fabric is as follows:

The two needle groups N^1 and N^2 are independently movable, but each group comprises two needles disposed side by side. The groups operate as previously described with the difference, however, that first two needles of the group N^1 move below the thread guide **1** disposed first in the operating direction R and immediately go up behind this guide, so that the thread *a* is placed behind the head of two needles N^1, whilst two needles of the group N^2 move under and past the other guide **2** and the thread *b* is not brought under their head. Furthermore, the sinker also comprises two differently movable groups P^1 and P^2 (Fig. 43). The sinkers P^1 are located between the adjacent needles of a group N^1 and N^2 (Fig. 41) and do not move like the sinkers P^2 between the needles and under the threads *a* and *b*, but remain outside the needle row in inactive position (Fig. 43). This is attained in known manner by imparting different length to the sinker feet P^d and P^e upon which two cam members act which also differ in length (Fig. 19).

As the thread *a* is sunk by two adjacent needles N^2 into long loops and not caught by two needles N^2, each loop of one of the other thread lies over two needles of both needle groups and extends from the sinker P^2 to the next sinker P^2 (Fig. 41), so that every loop **3** is brought over two needles under the hook in such manner that it is worked only in the next course together with new loops into a needle loop. In this way a crossing is formed between two needles of the group N^1 and two needles of the other group N^2, whilst the thread between two adjacent needles of a group N^1 or N^2 is worked into ordinary sinker loops **6** (Fig. 44), since between these two needles N^1 and N^2 or N^2 and N^2 no sinker stands in the row and thus longer sinking of this thread portion does not occur.

When the loops 3^a and 3^b are worked together with the new loop into a needle loop **4** and **5**, the long loop is drawn through two old meshes and the thread portion between the two needles also worked into an ordinary sinker loop together with the already formed sinker loop, so that all ordinary sinker loops are double-threaded, as shown in Fig. 4.

The operation of the needle groups relative to the thread guides may vary from course to course, as previously indicated, and from one sinking operation to the other one needle group may alternately operate and the other be eliminated.

The new group formation permits also a change in the association of the needles with the various groups, so that for instance the first and second, fifth and sixth, 9th and tenth needle of group N^1 and the third and fourth, seventh and eighth, 11th and 12th needle of the group N^2 work in one row and the next course is formed by the 2nd and 3rd, 6th and 7th, 10th and 11th needle of group N^1 and the 4th and 5th, 8th and 9th, 12th and 1st needle of the group N^2, etc. The operation of the two sinker groups must change accordingly. When in one row the sinkers P^2 are between the needles, P^1 must remain outside in the next row during change of the groups.

Similar to the fabric shown in Fig. 4 is that shown in Fig. 8, in which known plain fabric alternates with loops of the fabric according to the invention, in groups or according to pattern. Instead of plain fabric any other known fabric like 1:1, interlock, etc. may be used.

At the point where the known fabric extends into the new fabric an ordinary sinker loop **6** and a shank 5^a or 5^b will be found.

Fig. 42 shows by way of example how fabric according to Fig. 8 can be produced.

The needles are divided into two groups, according to their motions, a group E comprising in the example shown 3 needles and a group G also comprising 3 needles. Group E operates according to the method shown in Fig. 16, and group G operates normally, i.e. both threads *a*

and *b* are caught by all needles and worked into ordinary double-threaded loops. The sinkers P^1 between the needles of group G remain inoperative during sinking (Fig. 43), so that the threads are not made into long loops on the upper edge P^a. The sinkers P^2 between the needles of group E and the sinker P^3 which lies between every group G and E move according to the invention (Fig. 18) below the range of both thread guides 1 and 2 into the needle row, so that the threads are sunk by the needles of group E into long loops 3 which are brought according to the invention (Figs. 17 and 18) under the needle head and worked into needle loops in the next course. After the sinking operation the sinkers P^1 as well as the sinkers P^2 and P^3 move in the direction Z toward the needles, but do not carry loops (Fig. 44).

Fig. 6 shows a fabric with long loops 10 which are approximately twice as long as the long loops 5. The longer loops 10 of this course are in the next course but one worked into needle loops together with the long loops 5 of the intermediate course and the ordinary loop 4. In this way single-, double- and triple-threaded loops 4 or 4, 5 or 4, 5, 10 and crossings of the portions or shanks 5^a and 5^b or 10^a and 10^b, 5^a or 5^b and 10^a or 10^b, etc. are produced.

This fabric has an extraordinarily close Jersey- or crepe-like character.

Figs. 54–57 indicate the method of production.

The possibilities of procedure are practically the same as previously described with reference to Figs. 17 and 18 and 46 to 48, with the difference, however, that if a three-threaded needle loop is to be worked the sunk long loop 10^x, which is then made into the long loop 10, lies after sinking on the sinker edge P^a, as shown in Fig. 54, and is not hung over and placed under the needle hook, as the sinker does not advance any further toward the needles, but retains the sinking position according to the main method (Figs. 18 and 21). During further upward motion of the needles into pressing position the old mesh is pressed off (Fig. 55) and the loop 10^x remains behind the needle back on the sinker edge P^a. During the next sinking operation long loops 5^x (Fig. 56) are sunk near the loop 10 lying on this edge. Since during sinking of the thread to form long loops 5^x no loop 10^x of the preceding sinking operation is positioned under the hooks, the needles form only single-thread loops 4 of regular length. After the sinking operation the sinkers move toward the needles, which is necessary to bring loops over the needle head under the needle hook, so that both loops 10^x and 5^x (Fig. 57) are jointly worked into a three-threaded needle loop 4, 5, 10 during the following sinking operation together with the regular mesh 4.

Fig. 7 shows a fabric, in which the long loop is worked into a needle loop together with the regular loop not in the same weal but in the adjacent weal, so that a thread arrangement resembling warp goods is produced. The shanks of the long loops do not cross each other, but one shank 5^a or 5^b crosses the needle loop and the other shank surrounds the head of the double needle loop which in the same weal precedes the loop through which the long loop is drawn.

The method of producing a fabric as shown in Fig. 7 is indicated in Figs. 52 and 18, 58 and 59. The lateral racking of the loops can be effected before the sinkers move in the direction Z into hanging over position (Fig. 21) or after the sinkers are in this position (Fig. 22).

The mode of operation is the same as described with reference to Fig. 18. The only difference is that the long loops 3^a or 3^b are laterally racked one or two divisions after sinking and before the needles have moved up between the sinkers.

There are different possibilities of racking the loops into range of the adjacent needle.

In circular knitting machines presser wheels 12 (Fig. 64) may be employed which are driven by means of a rack E and a tooth D disposed on the shaft 13 for the presser wheels 12. The presser wheels 12 possess bevelled teeth. The teeth are bevelled on one side or the other, according to towards which side the sinkers are to be pressed, and the bevelled side acts on the sinkers. The differently bevelled teeth are designated 12^a and 12^b. A presser wheel is provided either with teeth 12^a or 12^b and can be hung over only towards one side. If a loop is to be hung over once in one direction and in the next course in another, a presser wheel 12, as shown in Fig. 62, possesses teeth 12^a and 12^b. If in a certain course some loops are not to be hung over laterally, the portion of the wheel 12 that ought to act on the sinker has no teeth (Fig. 63).

Figs. 58 and 59 show how the presser wheels 12 are pushed sideways into the adjacent division, when after the sinking operation the sinker has brought the loop 3^a or 3^b lying in its throat P^b in front of the needle head. This lateral pressing must of course occur before the needles move between the sinkers. Fig. 59^a, being a section of Figs. 58 and 59 on the line 59^a–59^a, shows the relative position of the sinkers and needles when lateral pressure begins. The position shown in Fig. 59^a corresponds to a position between those shown in Figs. 21 and 22. The sinkers are laterally pushed away by the teeth 12^a or 12^b of the presser wheels 12 to the extent of a needle division only until the needle has ascended far enough to be between the sinkers and holds back the laterally pressed sinkers from snapping back into normal position. The sinker retains the advanced position (Fig. 24 and line 24—24 in Figs. 58 and 59) in the adjacent division up to the pressing operation. After the pressing operation the sinkers move out of the needle row into inactive position and resume again the normal straight position (Fig. 25, line 25—25 in Figs. 58 and 59). The presser wheels exert pressure upon the sinkers in the foremost position of the latter while they are in a position of rest (Fig. 59^a, line 59^a—59^a in Figs. 58 and 59).

The presser wheel 12 (Fig. 58) which has only the teeth 12^b presses the sinker against the working direction R, so that racking of the long loops in the fabric shown in Fig. 7 is effected to the right. In the next course, in which racking takes place to the left, a presser wheel 12 is used that has only the teeth 12^a. As shown in Figs. 60 and 61, the teeth 12^a are so formed that the sinkers enter the adjacent division in the direction R which is the operating direction.

To permit pressing of the sinkers without causing deformation they must be made of highly elastic steel.

The other possibility of laterally racking the loops is indicated in Figs. 52 and 53 and is restricted to flat machines having a sinker bar plate and one or two needle beds of which one carries sinkers besides the needles, since after working of one course the needle bed or the sinker bed is racked one or two divisions in one direction and in the next course in the other direction. Otherwise, the mode of operating the

needles and sinkers is like the methods shown in Figs. 73, 74, 75 and 76 and described in the introductory portion of the description.

The fabric shown in Fig. 5 discloses a thread position with the fundamental connection according to Fig. 15 in which the long loops 3^a and 3^b are worked into needle loops in one course in the weal on one side and in the following course in the weal on the other side.

The method of producing such goods is indicated in Figs. 52, 52^a, 53, 53^a, 60 and 61. During production, at each sinking operation work is carried on in double division, so that the needle group N^1 forms the thread *a* into loops and long loops and the other needles N^2 are eliminated from the sinking operation. During the following sinking operation the interposed needles of the group N^2 work the second partial course out of the thread *b*, and the needles of group N^1 are cut off from the sinking operation. In the first partial course, Figs. 52 and 52^a, which is worked with the needles N^1, the long loop 3^a is hung over toward one side and in the next partial course which works the thread *b* into loops 3 with the needles N^2 racking is effected toward the other side.

Figs. 52, 52^a, 53 and 53^a show the working method in flat knitting machines in which racking is effected by lateral displacement of the needle or sinker bed.

Fig. 52 shows the sinking of the first partial course from the needles N^1, and Fig. 52^a shows the finished partial course with all needles in the elevated position shown in Fig. 21, the needles N^2 being in catching position, as indicated in Fig. 51. By lateral displacement of the needle or sinker bed the long loops on the sinkers in the position according to Fig. 21, prior to hanging over to one side, are racked to the left as shown in Fig. 52^a. Fig. 53 shows the sinking of the next partial course made of the thread *b* by the needles N^2, and Fig. 53^a shows the sunk partial course with all needles in catching position, and the long loops on the sinkers in the position according to Fig. 21 are racked to the right by lateral displacement of the sinker or needle bed. The long drawn out loops are always hung over before the needles go up out of the position shown in Figs. 52^a and 53^a into pressing position and—seen in working direction—before sinking. The change in the working direction in flat machines, as indicated in Figs. 52 and 53, has no influence upon these processes. The same applies to the cooperation of the sinkers and needles. In the method described with lateral hanging over of both loops 3^a and 3^b both partial courses are worked in one sinking operation and therefore is it possible to work the laterally transferred loop together with the new regular mesh into a needle loop, as both needle groups N^1 and N^2 participate in the following sinking operation.

According to the new method, the groups of the needles N^1 (Fig. 52^a) over which the long drawn out loops are hung have participated in the sinking operation. After the transfer of the loops (Figs. 22 and 23) these needles pass into the pressing position according to Fig. 24. During the next sinking operation the needles N^1 do not operate and the needles of the other group N^2 are working. Since during the following sinking operation the long drawn out loops hanging on the needles N^1 which are not cut off during this sinking operation cannot be worked out, the needles in their disengaged condition shown in Fig. 51 must pass up through the sinking point or position to prevent the old mesh from being thrown off over the needle head and the hung over loop from being under the needle hook.

The loops long drawn out by N^2 are now hung toward the other side. The needles N^1, after the lateral hanging over of the loops, go up into pressing position (Fig. 24) whilst the needles N^1 which now participate in the sinking operation, prior to the sinking step go up only to the extent shown in Fig. 25 so that the loops are not placed below the open latch but remain under the head up to the sinking step and are worked into a needle loop together with the newly sunk regular loops.

This means:

1. The needle which has worked a short mesh 4 and a loop 3 and to which the interposed long loop has been transferred
2. goes into pressing position, presses off the old meshes (Figs. 22, 23 and 24) and the loops remain on the open latch;
3. then this needle goes into the position shown in Fig. 51 and is eliminated from the following sinking operation,
4. whereupon this needle goes up into the position shown in Fig. 25,
5. then again into sinking position, etc.

1. The interposed needles, while the other needles form short meshes 4 and loops 3, go into the position shown in Fig. 51 and pass through this sinking operation
2. into the position shown in Fig. 25,
3. then into sinking position and
4. after this sinking operation needles and sinkers pass again into the position shown in Figs. 22, 23, 24, so that
5. the same position shown in Fig. 51 is attained again.

In circular frames or circular knitters the method according to Figs. 60 and 61 can be applied also, with the difference that the sinker or needle bar is not racked laterally but the sinkers are pressed into lateral divisions by means of presser wheels 12 having teeth 12^a and 12^b.

The fabric can be worked also according to Fig. 14 with lateral racking of the long loops, which changes from course to course. Such a fabric is of pronounced charmeuse type.

In the manufacture of such fabric, as indicated in Figs. 60 and 61, one needle group, which in Figs. 60 and 61 is N^1, forms in two successive sinking operations, also shown in the figures, short meshes 4 and loops 3, i. e. in one operation from the thread *a* and in the other one from the thread *b*. In this way the needles of the group N^1 form in the two successive sinking operations short meshes 4 and loops 3^a and 3^b. The needles of the group N^2 are eliminated from these two sinking operations and occupy the position shown in Fig. 51. After the sinking operation the needles N^1, which first form short meshes 4 and loops 3^a from the thread *a*, receive again their own loop 3^a owing to the fact that the sinkers in the hanging over position shown in Fig. 59^a are pressed in the working direction R into the adjacent division by a presser wheel 12 with teeth 12^a. The needles then move into the pressing position shown in Fig. 24 and initiate the next sinking operation in which they participate again to work the thread *b* into meshes 4 and long loops 3^b and the loop 3^a transferred to them into long needle loops 5. After the sinking of the long loops 3^b, when they are again in hanging over position (Fig. 59^a), the sinkers are pressed by a presser wheel 12 with teeth 12^b opposite to the working direction

into the adjacent division and the loops 3^b are hung over the needles N^1. After this transfer the needles N^1 pass into the pressing position shown in Fig. 24 and then into the catch position shown in Fig. 51, which the needles N^2 have occupied during the two sinking operations, whilst the needles N^2 ascend only far enough to prevent their loops from passing under the latch, i. e. the needles N^2 do not go into pressing position but into the position which they occupy according to Fig. 50 relative to the old meshes **4**, **5** lying on them and the hung over loops **3**.

In the next two sinking operations the same working cycles are repeated, with the difference that the needles N^2 carry out the motions of the needles N^1 and the latter those of the needles N^2. The working mode of the two needle groups N^1 and N^2 uniformly changes after every two sinking operations.

The goods shown in Fig. 10 resembles the fabric shown in Fig. 5. The only difference is that only one partial course is worked for instance on the needles of only one group N^1 or N^2 like a regular course from one thread and that, changing from course to course, the loops **3** located between the needle loops or the sinker loops are hung over the needles N^1 or N^2 alternately to the left and right and worked in the next courses into needle loops.

Hanging over may also take place toward one side of course.

The manufacture of fabric according to Fig. 10 may be carried out in the manner shown in Figs. 52 and 53, 58 and 59 and 60 and 61, with the difference, however, that only one thread is worked during sinking and only one needle group, whilst the other needle group is constantly eliminated from the sinking operation by passing without any variation in its vertical position through all systems and therefore forming no loops.

Lateral transfer of the loops is effected as described for all preceding methods, so that always the needle which sinks the thread (for instance N^1 in Fig. 52) receives the loop **3** positioned above this needle (Fig. 52^a).

Fig. 9 shows another variation in hanging over in a fabric worked with two partial courses in one row and with two threads.

In this example all loops of one partial course, which may show the fundamental connection according to Figs. 14 or 15, are worked in the following loop of the same weal into meshes **5** and loops 5^a, whilst the loops of the other partial course, changing from course to course, once to the right and once to the left, are worked in the following course of the adjacent weal located on the right or left into the needle loop **4** or **5** with the shanks 5^b.

It follows that always a three-threaded weal with the loops **5**, **5** and **4** alternates with a single-thread weal formed of meshes **4**. It is possible of course to provide for the change from a three-threaded to a single-threaded loop not only in the courses but also in the weals.

In the manufacture of a fabric as shown in Fig. 9 one may proceed by working each partial course in a separate sinking operation (Figs. 45, 47, 52, 75 and 76).

A partial course is for instance worked out of the thread *b* by the needles N^2, and its loops $3b$ are hung over the needles N^2, and the latter pass in the elevated position shown in Fig. 51 through the sinking point where the needles N^1 operate and work the thread *a* into meshes **4** and loops 3^a above the needles N^2, as indicated by the first sinking operation (seen in the working direction R) in Fig. 52. These loops 3^a are formed without lateral racking, i. e. hung again over the needles N^2 over which they are formed. The needles N^2 carry therefore the loops 3^b of the one partial course and the loops 3^a of the other partial course. During the following sinking operation when the needles N^2 are working the loops hanging on them together with the newly sunk meshes **4** are worked into long double loops **5**,**5**. The loops 3^b formed during sinking from the thread *b* are hung again over the needles N^2, etc.

The needle groups operate therefore from one sinking operation to the next in the following order:

Group N^2: Loops are hung over the needles N^2 by lateral racking;
Group N^1: Loops are hung over the needles N^2 without lateral racking;
Group N^2: Loops are hung over the needles N^2 by lateral racking;
Group N^1: Loops are hung over the needles N^2 without lateral racking, and so forth.

The long loops 3^a and 3^b are thus always worked in the weal of the needles of a group into double long loops **5**, **5** together with the mesh **4**.

If the needle groups are for instance to operate in the order N^1 N^1, N^2 N^2, N^1, etc., the needles which are to form the double loops **5**, **5**, that is, the needles N^2 (Fig. 32) in this instance, pass into the position shown in Fig. 51 not only after the transfer of the laterally racked loops 3^b during the sinking operation of the needles N^1 but also after the transfer of the loops 3^a formed by the needles N^1 during the following sinking of the needles N^1. During the next sinking of the needles N^1 the needles N^2 also pass into the position according to Fig. 51, but, as shown in Fig. 51^a, both loops $3a$ and 3^b are now under the head of the needles N^2 and the old meshes **4** and **5**, **5** lie on the closed latch. In the next two sinking operations the needles N^1 operate as described with reference to needles N^2 and move into the position shown in Figs. 51 and 51^a so that meshes **4**, long loops **5**, **5** and loops 3^a and 3^b are formed by them.

The fabrics according to the invention, in which, as shown for instance in Figs. 5, 7, 9 and 10, all or some long loops **3** are worked in a laterally disposed weal together with the newly formed regular meshes **4** into a long needle loop **5**, may be worked also in the manner shown in Figs. 36 to 40 according to which the laterally transferred loops **3** alone are made into a long needle loop **5** in the following courses. The motion of the needles must, however, always be such that the needle which is to form single-thread loops only goes into sinking position without any thread feed, so that the loop **3** arranged thereon during the preceding sinking operation is alone worked out to form the long loop **5**. This method can be applied when both partial courses are formed in one and the same sinking operation or in two successive ones.

Fig. 77 shows for instance the application of this method to a flat knitting machine, though it can be carried out also by circular knitters if presser wheels **12** of the type shown in Figs. 58, 59, 60 and 61 are available.

The application of the method indicated above as shown in Fig. 77 makes it possible to produce a fabric with laterally hung over loops **3**, which alone are worked into long needle loops **5** in the

following course, in the manner of the fabric shown in Fig. 5. The operation is as follows:

The operation to be described precedes the sinking operation shown in Fig. 77 when the thread *a* is formed by the needles N^1 into meshes 4 and loops 3^a and by lateral racking during the upward motion according to Fig. 23 is hung again over on the needles N^1. The needles N^1 on which the long loops 3 are hung again pass up as high as pressing position (Fig. 24), so that only the meshes 4 are brought below the latch on the needle shank. During this motion of the needles N^1 in this sinking operation which precedes the sinking operation shown in Fig. 77 the needles N^2 have worked the long loops into long needle loops 5 and have then passed out of the position shown in Fig. 49 up into pressing position (Fig. 40) without any hanging over of loops, so that the loop 5 arranged on the needles N^2 is placed under the latch. In the operation shown in Fig. 77 the needle group N^2 sinks the thread *b* into loops 3^b and regular meshes 4 and knocks over the long loop 5. In the meantime, the needles of the other group N^1 move down in the direction R before the thread guide 2 and into the position shown in Fig. 37 and then farther down into the position according to Fig. 38 and into sinking position without having received any thread and during this motion work the long loops $3a$ which they carry alone into long loops 5. After this sinking operation the loops 3^b formed on the needles N^2 are brought again upon the needles N^2 by lateral racking and hanging over according to Fig. 23 when the needle groups N^1 and N^2 jointly move out of the position shown in Fig. 49 into pressing position (Figs. 24, 40). The needles N^1 have therefore no loops, since by lateral racking the long loops are always hung again over the needle on which they were sunk. During the sinking operation following the one shown in Fig. 77 the needles N^2 work again long loops 3^b alone into a loop 5 as in the operation preceding the sinking operation shown, and the needles N^1 sink again meshes 4 and loops 3^a, whereupon the process shown and described is repeated.

In the example shown in Fig. 77 both needle groups participate in a loop forming operation during a sinking operation, although during a sinking operation a partial course is formed from a single thread only by one needle group. If a needle is to work two long loops alone without the regular mesh into long needle loops 5, 5, as indicated in Fig. 9, though with the difference that the long loops are staggered in the weal, the needles N^1 or N^2 pass like the needles N^1 in Fig. 77 into a position shown in Fig. 23. These needles with their hung over loops 3 then move into the position shown in Fig. 24, then again into the position shown in Fig. 37 and Fig. 38, whereupon not the sinking position is occupied as in the preceding examples, but the needle passes on the level of the position shown in Fig. 51 through the working system, and the loops 3^b sunk by the needles N^2 are not laterally racked but are hung over the needles N^1. These needles then do not pass into pressing position like the needles N^2, but move only as high as shown in Fig. 50. During the following sinking operation the needles N^1 pass before the thread guide in the operating direction R into sinking position, so that both loops 3^a and 3^b alone, without having received thread and without forming a mesh of ordinary length, are worked into two long needle loops 5, 5 on one needle, namely needle N^1. During this operation of the needles N^1 the needles N^2 form the thread into regular meshes 4 and long loops 3, whereupon the long loop formed by the needles N^2 is hung again over the needle N^2 by lateral racking, and both needle groups N^1 and N^2 go into pressing position as shown in Figs. 24 and 40. Then the working mode of the needles is repeated, that is, needles N^2 carry out the motions of the needles N^1 as just described and needles N^1 those of needles N^2.

Fig. 11 shows an example of plated fabric which is like the fabric shown in Fig. 1 plated in a novel manner.

To plate in the known manner all fabrics according to the invention would require four-threaded loops. An example is shown in Figs. 45 and 47.

To plate the loops double-threaded, that is, to arrange the two threads present in the fabric according to the invention in plating manner if they are different or differ in color, care must be taken that the hung over long loop is not alternately placed on the front side, as indicated in Fig. 11. It follows from the examples shown and described that the hung over long loops 3 as long needle loops 5 always lie on the outside of the face side and the short meshes 4 always on the outside of the back. Each needle loop in the weal 2 and the course 3 (Fig. 11) comprises a long white loop 5 and a black loop 4 of ordinary length. The white loop 5 lies in the next loop on the outside of the front side (weal 1, course 3). The short mesh 4 lies outside on the face side and the long loop 5 formed of the loop 3 is laid so that it lies outside on the back. According to the invention, this is done for instance in the manner shown in Figs. 65 and 66 by pressing back the needle N^1 on which the long loop 3 hangs which is worked into the long loop lying on the back at the moment when the newly sunk loop 2 meets the hung over loop 3 in the needle head. By the depression of the needle N^1 the hung over loop 3 is then caused to alter its position in the needle head in such manner that as loop 5 it is placed before the newly sunk loop 2 which then becomes mesh 4 outside on the back, whilst on the needles N^2, which are not pressed back, the loops 3 lie behind the newly sunk loops 2 in the needle head, so that the loop 3 formed into a mesh is placed outside on the face side and the mesh 4 formed of the loop 2 outside on the back.

The fabric according to the invention may be worked also with plush loop lining, as shown in Fig. 78. In this fabric in which the plush loops are worked in in the manner of loop-plush fabric the arrangement according to Fig. 1 is chosen as basis. The plush loop F is tied up between the long loops 5 and the regular short meshes 4 are tied into needle loops 7 and long sinker loops 8.

Figs. 79 and 80 show a manner of producing goods according to Fig. 78. The mode of operation of the sinkers and needles for working the ground fabric is the same as that shown in Figs. 17 and 18 and described above, with the difference that another thread F is fed to both needle groups N^1 and N^2. The guide 11 for the thread F, in order to obviate the necessity of varying the needle motions, is arranged so much lower relative to the needles than the two other thread guides 1 and 2 are with respect to the threads *a* and *b*, so that the thread F is always brought under the hook of the needles of both groups. Whilst during sinking the thread *a* is worked into needle loops 4 and long loops 3^a by the needles N^2 and the thread *b* into needle loops 4 and long loops 3^b by the needles N^1, the thread F is

worked by all needles N^1 and N^2 (Figs. 79 and 80) as second thread over the edge P^a of the sinker P into long sinker loops **8** and needle loops **7**. Since the thread F is formed on one sinker only into a plush loop **8** and not worked like the loops 3^a or 3^b on two adjacent sinkers P over and beyond a needle division, the plush loops are not brought upon the needles during the motion of the sinkers for hanging the loops 3^a or 3^b over the needles (Fig. 80), but remain only on the sinkers P until they move in the direction V out of the needle row and are thrown off (Figs. 79 and 80). The plush thread F, which owing to the position of the thread guide occupies the position taken by the ground thread during plating and thus lies before the threads *a* and *b* on the face side, is covered by the hung over loops 3^a and 3^b or the long loops **5** formed therefrom which are always on the face side of the goods, so that the needle loop **7** is placed between the meshes **4** and the needle loops **5** (Fig. 78).

Fig. 12 shows an example of weft fabric with a ground fabric according to Fig. 2, in which, as indicated for instance in Fig. 15, every other course consists of a partial course M—M and the interposed courses are worked out of the other partial course N—N. In this weft fabric each partial course M—M is provided with a weft thread S in such manner that it lies in the partial courses M—M between the needle loops **4**, **5** and the shanks 5^a of the long loops **5** which extend from the mesh **4** of the preceding partial course to the meshes of the next partial course. In the other partial course *a*—*a* the weft thread S is placed between the needle loops **4**, **5** and the shanks 5^b of the long loops **5**.

This kind of weft fabric is quite close, as each total course comprises two partial courses M—M and N—N, so that two weft threads lie over each mesh, each of which is separately tied and lies closely to the next one.

Figs. 75, 76, 73 and 74 show a method for producing goods shown in Fig. 12. According to this method only one needle in a system works a thread *a* into meshes and long loops 3^a, and the other needles N^2 are eliminated by passing through the system in the low position shown in Fig. 73. Where the needles have reached this low position, a weft thread guide **10** is disposed between the lower sinker edge P^c and the upper edge K of the needle bed, which lays the weft thread S (Fig. 73) so as to be placed behind the needles which, after the thread passes to the next system, go up again, which in this instance are the needles N^2. In the next course, the weft thread is placed again behind the needles N^1, so that by this change of operation of the needle groups N^1 and N^2 and owing to the positioning of the weft once behind the needles N^1 and then again behind the needles N^2 the weft thread S will have the position shown in Fig. 12, since it is placed between the loops 5^a or 5^b of the loops **3** and the meshes **4** hanging on the needles (Fig. 74) after it has been inserted behind the ascending loops and the long loops **3** have subsequently been hung over these needles.

The weft fabric according to Fig. 13 comprising two partial courses in a course corresponds to the fabric shown in Fig. 1 and has only one weft thread S for each course, which lies between all loops 5^a or 5^b of the long loops **5** and the needle loops **4**, **5** of the course concerned.

To produce such fabric both partial courses are simultaneously worked, as indicated in Figs. 71 and 74. The same method is shown in Figs. 17 and 18, though without working in weft threads. Both needle groups N^1 and N^2 sink the thread *a* and *b* and on having reached their lowest position, the weft thread is inserted as described above. It follows, as shown in Fig. 13, that the two partial courses worked into one course have only one weft thread which lies between all loops 5^a, 5^b of the long loops and all meshes **4**, **5**. All loops 3^a and 3^b of both partial courses, after the weft thread has been laid (Fig. 73), are hung after and during the rising of the needles N^1 and N^2 over all needles, so that the weft thread lies behind all needles between the loops 3^a and 3^b and the needle meshes **4**, **5** (Figs. 71, 72 and 74).

The method just described with respect to the motion of the weft thread can be applied also to all other fabrics according to the invention, which use weft threads.

The methods described and shown can be carried out and the fabrics produced by knitting machines having two rows of needles. A fabric can be made for instance which partly consists of the fabric according to the invention and partly of known goods of the type hitherto made on knitting machines having two rows of needles, such known goods being for instance 1:1 and interlock.

According to the invention, it is further an object thereof to provide for selectively using known knitting machines either for making goods according to the invention or known types of fabric of the class that can be produced thereon.

The method of producing fabric according to the invention is the same as previously described, and the mode of operation of the two rows of needles during production of known goods remains as usual.

For carrying out the method according to the invention on knitting machines having two rows of needles one of the two needle beds is fitted with hang-over sinkers in addition to the needles. These sinkers correspond in configuration and operation to the sinkers P shown in Figs. 19 to 26. To prevent the annular projection T on the cam of such machines, which holds the ribbing needles in their guide, from interfering with the motion of the sinkers, the latter are provided on their upper edge P^k facing the annular projection T with a recess P^u which is equal in length to the path of the sinker from inoperative into operative position plus the width of the projection T.

Where goods according to the invention are to be made, the needle or needles of the row in which the hang-over sinkers are arranged are cut off from their loop forming work and for each eliminated needle two sinkers on either side of the needle are actuated (Figs. 19 to 26). This can be seen also in Fig. 82 which shows the needles N of the needle row in which the sinkers P are disposed in inoperative position, i. e., the sinkers P are in hanging over position according to the sinkers in Fig. 22. The needles of the other row, which are divided into two groups N^1 and N^2, operate in accordance with the kind of fabric to be made in the same manner as in machines having only one row of needles.

If known goods that can be produced on a machine with two needle rows, such as 1:1, interlock, etc. are to be made, the two sinkers P disposed on either side of a needle in the row N are held inoperative, as indicated in Fig. 81. The needles N, N^1 and N^2 of both needle rows operate at these points as usual.

If regular meshes and meshes according to the

invention are to be worked in a course, as indicated in Fig. 84, the needles of the rows N^1 and N^2 work regular meshes on N^2, whilst on every other interposed needle N^1 the long loop sunk by the two superposed sinkers P is hung over and worked into a loop. The other needles N^1 are eliminated like the needles of the row N^2 with the exception of those needles which are positioned above the eliminated needles N^1 of the rows N^1 and N^2.

To permit sinking of long loops **3** to be worked out into long needle loops **5**, the sinking edge P^a of the sinker P (Fig. 84) lies on a higher level than the needles N, over which the thread is sunk when regular fabric is worked.

Some of the sinkers P may be pushed into the adjacent division by means of presser wheels **12** (Fig. 63) in order to effect lateral racking of the longer drawn out loops towards one or the other side for all or some loops. Where the needles N operate no teeth 12^a or 12^b are provided in the wheel **12**.

If on such knitting machines having two rows of needles and being equipped according to the invention only ordinary known fabric is to be made, it will only be necessary to disengage the sinkers P, as indicated in Fig. 81. If only goods according to the invention are worked, all needles of the row N are disengaged, as shown in Fig. 82.

It is further possible to work on such machines having two rows of needles fabric according to the invention together with ordinary plain fabric. For this purpose the sinkers P are provided in known manner with two pattern feet P^d and P^e. The sinkers with the foot P^d are for instance brought into proper position for producing goods according to the invention, whilst the sinkers with the foot P^e operate as in plain goods.

The arrangement of the sinkers between the needles of one row can be made in various ways. According to Fig. 83, the needles of the row N register with the gap in the other row N^1 and N^2 and the sinkers are milled at the side of the needles, so that each sinker abuts against one side of the needle stay.

Fig. 84 shows a circular knitting machine, in which the needles of one row are arranged on the needles of the other row. In such machines the sinkers are disposed in slots cut into the center of each needle stay.

At the same relative arrangement of the two needle rows the sinker slots, according to Fig. 85, may be cut into a stayless needle bed in such manner that the sinkers inserted in the slots and moving therein take over all the function of the needle stay. This arrangement is particularly advantageous in fine gauge machines.

In the examples shown, the method described is applied to machines having latch needles, the latch serving for separating the old mesh on the needle from the newly hung over loop both when the latch is opened and closed (Fig. 26).

If the methods are to be applied to machines provided with spring needles, the function taken over by the latch in latch needle machines must be carried out by other means.

For example, Figs. 86 to 90 show that in such case sinkers P^z of known type can be used which move toward the needle back and thus towards the other sinkers P^v. Separation of the long loop **3** from the loops **4**, **5**, which in latch needle machines is effected by the latch, is brought about in machines according to Figs. 86 to 90 by the nose P^n of the sinkers P^v.

The method is carried out as follows:

The sinkers P^z operate in the same manner as the sinkers described before, and it is therefore only necessary to described the position of the other sinkers P^v. Fig. 86 shows the sinking of the loops **4** and of the long loops **3** on the edge P^a of the sinkers P^z, whilst the sinkers P^v are in inoperative position and about to move in the direction V toward the needle breast into operating position. Fig. 87 shows this sinker P^v in operating position, i. e. knocking over position, and the sinkers P^z have moved in the direction Z towards the needle breast into hanging over position, so that the needle when going up can pass through the long loops. Fig. 88 show the position of the long loop hung over on the needle and separated from the meshes **4**, **5** on the needle by the nose P^n of the sinkers P^v. The latter have receded somewhat from their knocking-over position, but only to such an extent that their nose is still in the needle row and separates the meshes **4**, **5** from the long loops **3**. In the meantime, the sinkers P^z are inactive, whilst the needles get new thread *a* and *b*, or *a* or *b*. Fig. 89 shows the pressing position in which the sinkers P^v with their nose P^n are still in the separating position shown in Fig. 88. The needles have moved down into pressing position and are pressed off by a press member W or other suitable means when the point of the needle hook is above the meshes **4**, **5** on the needle shank and the long loop **3** lies under the hook. During farther descent of the needles into sinking position the meshes **4**, **5** are pressed off over the needle and the long loop **3** under the hook is worked out with the thread *a* or *b* into a loop or sunk over the edge P^b of the sinkers P^z to form new long loops. During this sinking operation the sinkers P^v move out of the needle row in the direction Z, so that the loops **3** are released by the separating point P^n when the meshes **4**, **5** are disposed on the closed hook of the needles and the sinkers and needles occupy again the relative position according to Fig. 86. If ordinary plain fabric is worked, the sinkers P^z are withdrawn in the direction V (Fig. 90) that they are eliminated from the loop forming process, whilst the sinkers P^v carry out the regular motions.

If the method shown in Figs. 67 to 69 is to be applied to machines having spring needles, sinkers moving toward the needle back are not used but only sinkers that move toward the needle breast. The long loops are kept separate from the meshes **4**, **5** on the upper edge of the nose P^n, as shown in Fig. 95, and are pressed off, as indicated in Fig. 89.

Separation of the meshes **4**, **5** from the long loops **3** by means of the nose P^n of the sinkers P^v can be effected also in machines having latch needles if two sets of sinkers P^v and P^z are provided. The function of separating is thus carried out jointly by the latch and the nose P^n. The working position of the sinkers and needles relative to one another according to Figs. 91 to 94, which indicate the range of uses of two sets of sinkers in case of latch needles, is the same as in Figs. 86 to 89. The relative position of the latch needles to the sinkers P^z (Figs. 91 to 94) is also the same as previously described.

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