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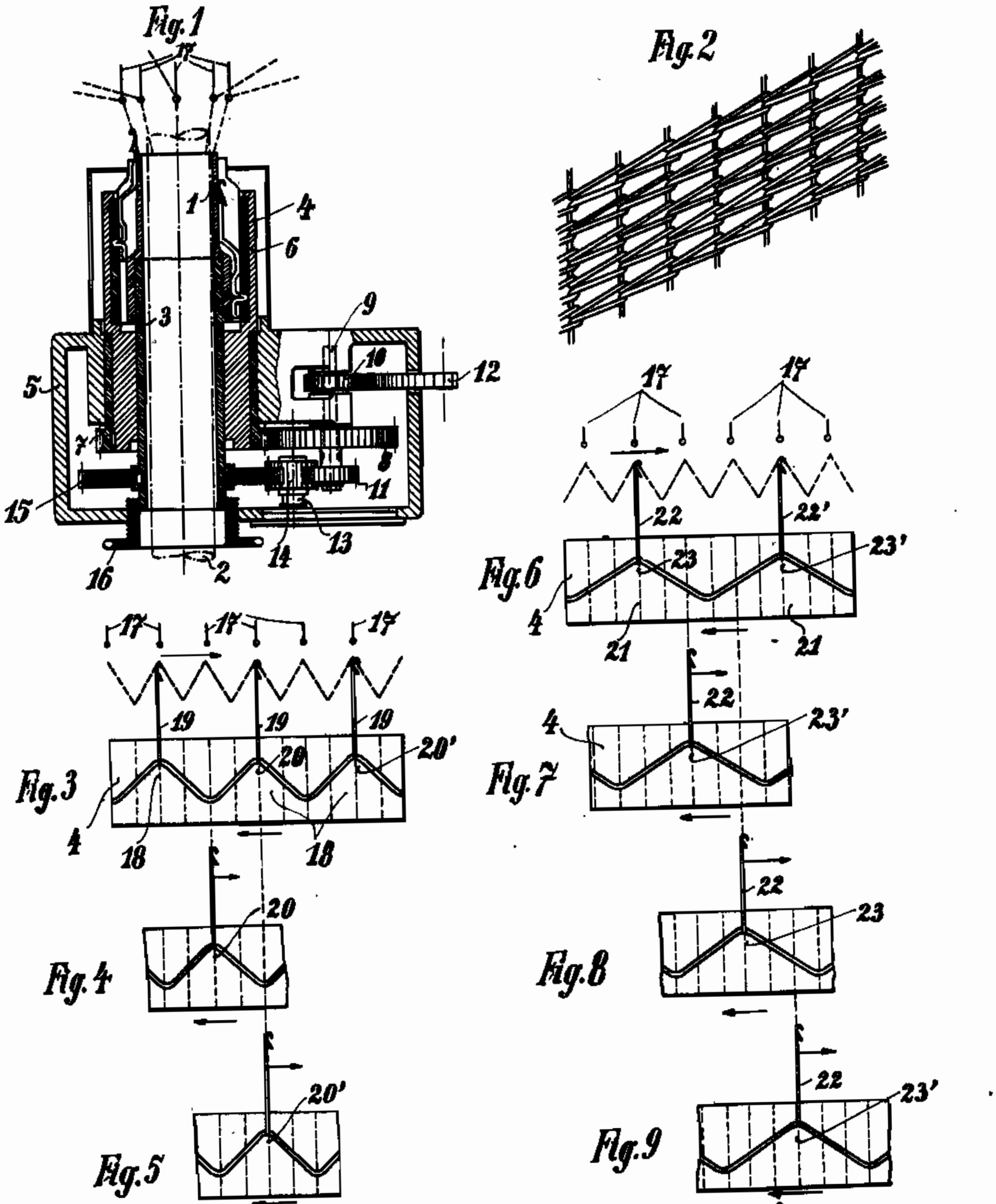
MAY 4, 1943.

BY A. P. C.

F. MEIWALD
MACHINE FOR KNITTING CABLE
COVERINGS AND THE LIKE
Filed Dec. 16, 1938

Serial No.
246,213

3 Sheets—Sheet 1

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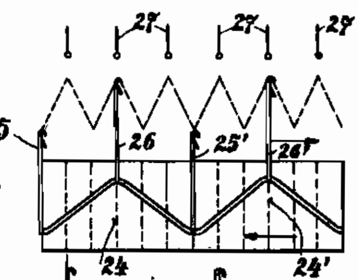

Fig. 10

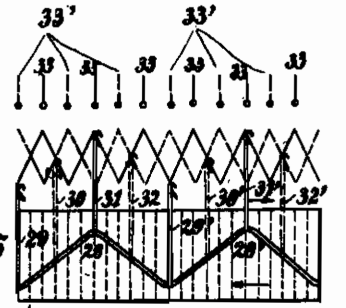

Fig. 15

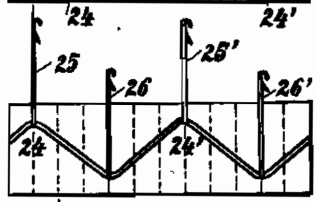

Fig. 11

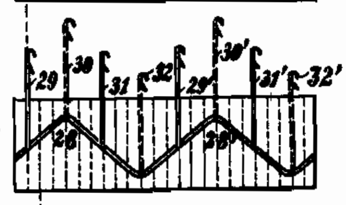

Fig. 16

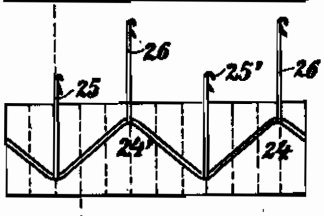

Fig. 12

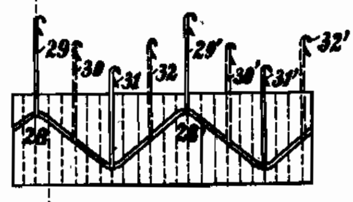

Fig. 17

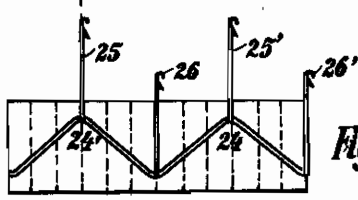

Fig. 13

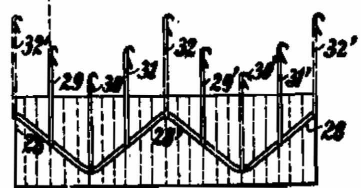

Fig. 18

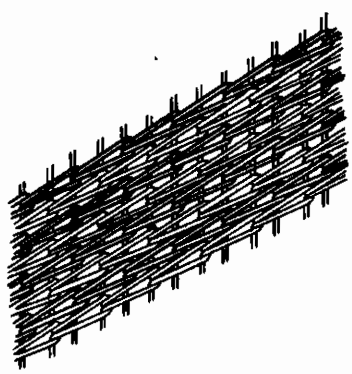

Fig. 14

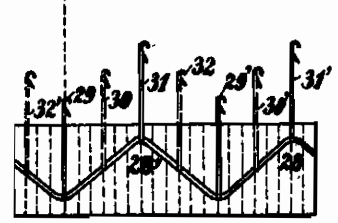

Fig. 19

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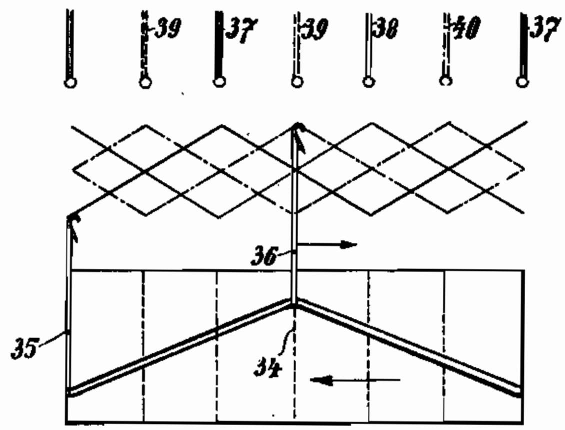


Fig. 20

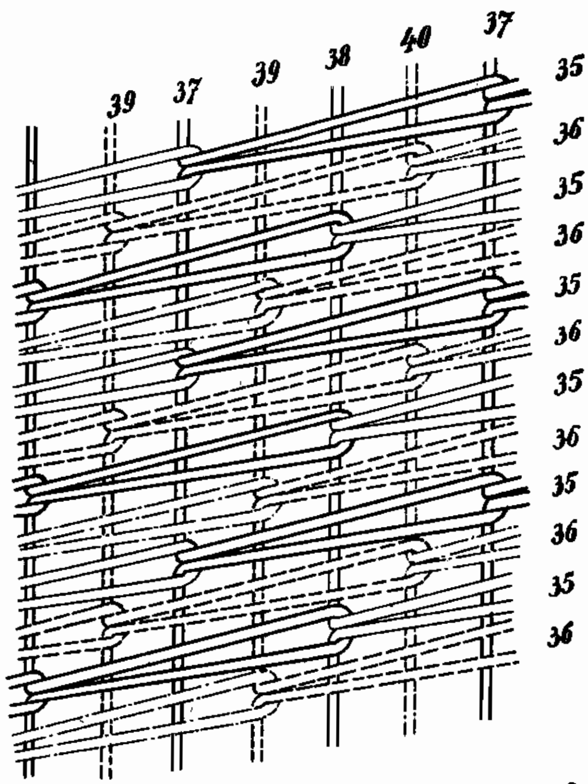


Fig. 21

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# ALIEN PROPERTY CUSTODIAN

## MACHINE FOR KNITTING CABLE COVERINGS AND THE LIKE

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Application filed December 16, 1938

Pliant electric conductors having knitted tubular shaped coverings whose loops and knots encase the conductor spirally are not new. In knitting machines for the manufacture of such coverings, a cam cylinder and a bobbin disk are rotated at a rapid speed and this causes rotation of a needle cylinder in a manner which results in the twisting of the loops. Although the output of these machines is considerably greater with identical motive power, compared with that of a bobbin machine and greatly exceeds that of weaving machines with less power use, nevertheless this manner of knitting coverings and casings has been generally abandoned, and coverings are now made by knitting machines in which both the grooved cam and the bobbin disk remain stationary, but in which the needle operating cylinder is given a high rotating speed. This produces knitted coverings in which the loops run spirally around the conductor, while the knots form lines parallel to the axis of the conductor. Compared with the first mentioned coverings, the advantage here lies in a faster rate of production, since the disk carrying the material bobbins does not rotate and the rate of speed of the machine can therefore be increased, causing the coverings to have smoother surfaces. In such coverings, the length of each mesh depends, in addition to the diameter of the conductor and the feeding action, on the number of high points in the cam having a lock forming groove. If, for instance, four high points are provided in this groove, each needle produces at one rotation of the needle cylinder four stitches, so that therefore, each stitch misses the fourth part of the length of the band so produced during one revolution of the needle cylinder. Since in providing four high points in the groove, the diameter of the cam is about three times as great as the diameter of the cylinder head, the knitting of cables of greater diameter is limited because an increased diameter with a medium stitch length would require more than four high points in the groove, in which case the diameter of the cam would increase at a more rapid rate than the diameter of the cylinder head.

Should, for instance, the diameter of the cable to be covered increase by 1.5 mm and should the upward motion of the loops around the conductor, as well as the length of the stitch be held evenly, a number of additional stitches is required, depending on the diameter of the cable, as well as a like number of high points in the groove whose mounting in the cam cylinder would require an increase in diameter of 12.5 mm. This would result, however, in the forced shortening of the base of the needles engaging the cam groove against the needle shaft, which makes the guiding of the needles in the grooves of the cylinder unusually difficult, since with too great shortening, the needles wabble and offer great resistance to their guidance. To guide the needles by means of elements as, for instance, bi-armed levers, mounted between the base of the needles and the cam curve is impracticable because of involved construction. To be able, therefore, to knit coverings around cables of great diameter whose loops run spirally around the conductor and whose knots form parallel lines to the axis of the body, the cam cylinder of the machine, which prior to the present invention has been fixedly mounted, is given an increased number of rotations with respect to the needle actuating cylinder in such manner that the product of the number of stroke effecting cam points and a selected factor plus 1 gives a whole number which at the same time determines the number of the thread guides mounted on the needle cylinder and remaining fixed.

With the foregoing and other objects in view, the invention consists in the details of construction, and in the arrangement and combination of parts to be hereinafter more fully set forth and claimed.

In describing the invention in detail, reference will be had to the accompanying drawings forming part of this application wherein like characters denote corresponding parts in the several views, and in which:

Figure 1 is a vertical section to a portion of a knitting machine constructed in accordance with this invention;

Figure 2 shows a developed section, to an enlarged scale, of knitting effected by the machine shown in Fig. 1;

Figures 3, 4 and 5 illustrate schematically the action of a machine constructed in accordance with this invention, wherein the needle actuating cam cylinder has three high points and revolves once for each counter revolution of the needle cylinder;

Figs. 6 to 9 show schematically successive steps in the actuation of the machine of this invention, wherein the needle elevating cam cylinder rotates twice in an opposite direction to a single rotation of the needle guiding cylinder;

Figs. 10 to 13 show schematically an arrangement similar to that shown in Figs. 6 to 9, but wherein the number of needles is duplicated;

Fig. 14 illustrates schematically a development of the knitting accomplished by the arrangement shown in Figs. 15 to 19;

Figs. 15 to 19 show schematically an arrangement similar to that shown in Figs. 6 to 9, but wherein the number of needles is quadruplicated;

Fig. 20 shows a further schematic arrangement of the invention;

Fig. 21 illustrates schematically a development of the knitting accomplished by the arrangement shown in Fig. 20.

The needle cylinder 1 (Fig. 1) which is provided with a bore for the insertion of the cable 2 having a somewhat greater diameter than the cable, is mounted in a casing 3 by simply fitting it thereon. Casing 3 runs in a casing 6 which carries a cam cylinder 4 and which is mounted in the frame 5 of the machine. The casing 6 has at its lower end a gear 7 engaging the gear 8 of a shaft 9. On the shaft 9, two gears 10 and 11 are fixedly mounted, and the gear 10 engages a gear 12 that is actuated by means of a motor not shown in the drawing. Gear 11 is removably mounted on shaft 9 and engages an idler gear 14 mounted on a swinging arm 13. The gear 14 engages a gear 15 fixed on the lower end of the casing 3. In order to change the length of the meshes, casing 3 is adjustable in height by means of a nut 16. Thread guides 17 are fixedly mounted opposite the cylinder head.

To produce the mesh formation shown in Fig. 2 with six meshes on the diameter of the conductor for each needle, there was formerly required a cam with six high cam points which necessitated a comparatively large cam diameter, thus causing difficulties in the operation of the needles. According to the present invention, the same mesh formation is produced with only three cam high points by giving the cam cylinder a counter rotating movement to the needle cylinder, in such manner that in one revolution of the needle cylinder, the cam cylinder makes a complete counter revolution. If desired, the same mesh formation can be produced by providing two cam high points in the cam cylinder by giving the cam cylinder twice the number of revolutions of the needle cylinder in counter-rotative movement. To describe the operation of each knitting needle during the above mentioned counter-rotative movement of the needle cylinder and the cam cylinder, for simplification these will be described in a case where only one knitting needle is provided for each of the above mentioned three cam high points 18 in the cam cylinder 4. As can be seen from Figs. 3–5, each knitting needle 19, therefore, would be lifted, when the needle cylinder 1 and the cam curve rotate counterwise at even speeds, by a partial rotating movement of the needle cylinder at half the distance of two high points, through the cam high point 20 which has met it in the meantime (Fig. 4), so that the needle hook is lifted and lowered once and thereby forms a mesh. In the following partial rotation of the needle cylinder, the needle is again lifted by the following cam high point 20′ and a new mesh is knitted. Since three cam high points are provided, each needle is therefore lifted and lowered six times during each full revolution of the needle cylinder, i. e. six meshes are knitted. The path of movement of the needle hook has been shown in dotted lines in Fig. 3.

If only two high cam points 21 are provided in the cam cylinder 4, the latter is rotated twice as fast counterwise as the needle cylinder, in order to produce the required number of meshes for each needle during one revolution of the needle cylinder. In the running of the machine, therefore, gear 11 must be exchanged for a gear with twice the teeth and the swinging arm 13 must be correspondingly adjusted to properly position idler 14.

In Figs. 6–9, the mesh formation in this case is described in greater detail. When the knitting cylinder, together with needles 22,22′, is moved in the direction of the arrow by one-third of the distance of the cam high points 23,23′, the cam curve rotates twice, so that one of the needles 22 comes to rest on the high point 23′ of the cam and has therefore been lowered and raised once, forming a mesh. In the next partial rotation of the needle cylinder and the needle the same distance, the cam high point 23 of the second needle lifter comes to rest in the position of needle 22, so that the latter is again lifted and lowered and forms a second mesh (Fig. 8). In Fig. 9, the position of needle 22 can be seen, in which the needle cylinder has made half a rotation and the cam cylinder a complete turn. Needle 22 has been advanced from the position of Fig. 8 by an additional third of the distance of the cam high points from each other and cam high point 23′ has arrived in the same place so that the needle is lifted and lowered a third time. During the described movement, the needle hooks of the needles 22,22′ have finished the course indicated in Fig. 6. At the cam high points of the course of the movement, the insertion of the thread in the hooks of the needles takes place, so that between two cam high points of the described embodiment, three thread guides are provided and in all, six thread guides 17 are shown.

In the embodiment of Figs. 3–5, only two thread guides are provided, corresponding with the course of movement of the needle hook for each cam high point. Since in this embodiment, however, three cam high points are provided, there results again a total number of six thread guides 17. From the course of movement of the needle hooks shown in Figs. 3–5 and 6-9 can be seen that by means of the counter rotating movement of the cam cylinder, an apparent increase in the number of cam high points in the cam cylinder 4 results, that is in both embodiments six cam high points are effectively produced by one rotation of the needle cylinder, since each needle during one rotation of the needle cylinder is lifted up six times. Since in the first embodiment (Figs. 3–5) three cam high points are present in the cam, the factor for obtaining the six effective cam high points is "two." while in the second embodiment (Figs. 6–9) in which two cam high points are present in the cam cylinder the factor is "three". From the sum of the number of rotations of the needle cylinder and cam cylinder relating to one rotation of the needle cylinder, the above mentioned factor results. In the first embodiment, the number of rotations of the cam cylinder in one rotation of the needle cylinder is "one" and its sum "two", so that by three cam high points six apparent cam high points result.

In the second embodiment with two cam high points in the cam cylinder, the latter makes by one rotation of the needle cylinder, two counter rotating movements so that the sum is "three" and the number of the effective cam high points is six. In general terms, the equation is the relation between the number of movements of the cam cylinder and the needle cylinder increased by the value one.

Should instead of one needle a plurality of needles be mounted for each cam high point in the cam cylinder 4, the cam cylinder receives an increased number of rotations relative to that of the needle cylinder, depending on the number of the needles acting on each cam high point, in order that each needle may be brought into knitting action.

Fig. 10 shows a cam cylinder with two high points 24, 24'. For each high point there are two knitting needles 25, 26 and 25', 26'. The actuation of the cam cylinder follows in such manner that while the cylinder makes one complete rotation, the cam cylinder makes two counter rotating movements in harmony with the two needles riding on each cam section. The needles 25, 25' successively reach the high points after 1/12 rotation of the needle cylinder (Fig. 11) and rest on the high points 24, 24' of the cam and are therefore lifted to receive the thread, while the needles 26, 26' are at the same time at the lowest points of the cam curve and form a mesh. In the next 1/12 turn of the needle cylinder (Fig. 12) the needles 25, 25' reach the lowest points of the cam, while the needles 26, 26' are lifted by the cam high points 24' and 24 for the reception of the thread. After a quarter turn of the needle cylinder and a half turn of the cam cylinder from the starting point in Fig. 10 to the point in Fig. 13, the needles 25, 25' are again lifted by the cam high points 24' and 24 while the needles 26, 26' are again lowered. The heads of all the needles are guided in the path shown in Fig. 10 during the described part turn of the cylinder and the cam cylinder, so that each needle is lifted up six times and knits six meshes during a complete rotation of the needle cylinder. At each point at which the needles are lifted, a fixed thread guide 27 is mounted. When three, four, etc. needles are provided for each high point, the cam cylinder counter rotates thrice, four times, etc. as fast as the needle cylinder.

Knitted coverings with a circum-knitted formation (Fig. 14) in which the knots of one row of meshes form a zigzag line with the knots of the other meshing row, that is, knitted coverings which consist of two single coverings meshed into each other whose loops cover each other, can be made as known by means of two cam cylinders mounted within each other, whose cam curves show two staggered high and low points. The staggering must be so selected that with simultaneous drive of both cam cylinders the path of the movement made by the heads of the two needle groups forms two or more facing wave lines.

According to the invention, such coverings can also be made with only one single cam cylinder if an even number of needles is grouped for each stroke of the cam cylinder and if the cam cylinder opposite the needle cylinder is given a number of revolutions corresponding to half the number of the group of needles acted upon.

In Figs. 15–19 a cam cylinder is shown with two high points 28, 28' and in which in the needle cylinder a total of eight needles 29—32 and 29'—32' are provided so that for each high point four needles rise in succession. When the cam cylinder receives double the revolutions of the needle cylinder, the needles perform as if each half of the needles had been mounted in two cams whose high points are staggered, as will be described further on. After a 1/24 revolution of the needle cylinder from the position shown in Fig. 15, needle 29 comes from its deepest position to the intermediate position shown in Fig. 16, because of the counter rotation of the cam cylinder at 1/12 revolution, while needle 30 goes from its intermediate position to its highest point. After an additional part revolution of the needle cylinder and the cam cylinder in the described proportion, needle 29 arrives at its highest point (Fig. 17) while needle 30 arrives at its intermediate position. Needle 31 which was at its highest position in Fig. 15 has in the meantime reached its lowest point, while needle 32 which was at its lowest point in Fig. 16 has arrived at its intermediate position. Fig. 18 shows the position of the needles after an additional part revolution of the needle cylinder and the cam cylinder in relative position. Needle 30 has now reached its lowest point while needle 32 has arrived at its highest position, and needles 29, 31 are in the intermediate position. In Fig. 19, needle 29 has again arrived at its lowest point after a ⅙ revolution from the starting position shown in Fig. 15 of the needle cylinder and ⅓ revolution of the cam cylinder, that is it has been lifted and lowered and has so made a stitch. The other needles 30—32 are now in the same group position on the point 28' as in Fig. 15. Needles 29'—32' which stood on the point 28' in like grouping in Fig. 15 complete, during the described part revolution to the position shown in Fig. 19, the same movements as needles 29—32. Fig. 15 shows the course of movement of the needle hooks during an entire revolution of the needle cylinder, each needle is lifted and lowered six times, during which needles 29, 31, 29', 31' and needles 30, 32, 30', 32' each are held in one group, whose needle hooks describe identical paths, in which the paths of the two groups, however, are staggered. At the height of the movement, a thread guide is provided for each group, that is six thread guides 33 and 33' for each knitting cover. Since the factor of the number of revolutions of the cam cylinder compared with the needle cylinder plus one makes "three" and two lifts are provided in the cam cylinder, each knitting cover has again six thread guides. The invention, therefore, makes a knitting cover as, for instance, shown in Fig. 14 with only one single cam cylinder by means of definite choice of needles in the cylinder, the number of lifts in the cam cylinder and the counter revolutionary speed between needle cylinder and cam cylinder, which cover consists, as known in the art, of two single knitted covers knitted into each other. In the presented embodiment, six needle lifters would be necessary in the cam cylinder if the usual rigid cam curves opposite each other were used, while the high points of these lifters would have to be movable. This would require also a comparatively large diameter of the cam cylinder.

If it is desired to make a knitted cover with more than two inter-knitted single covers, for instance, "$n$" covers, the number of knitting needles in the cylinder is selected to equal "$n$" times sum derived from the number of high points in the cam cylinder plus the integral ratio (whole number) between the number of rotations of the cam cylinder and the needle cylinder. The number of the locally rigid needle guides then is equal to "$n$" times the number of high points in the cam cylinder plus the number of knitting needles.

Under the same proportions, a knitted cover with "$n$" inter-knitted single covers can be produced, if the sum from the number of high points in the cam cylinder and the ratio plus 1 of the number of rotations of the cam cylinder and the needle cylinder is an improper fraction and is not described above a whole number, to which, however, is added the advantage of a closer cohesion of the single covers, since each needle does not always take the thread from the same group of thread guides, but takes it alternately from two or more groups.

In the schematically shown embodiment of Fig. 20, the cam cylinder shows only one high point **34** and is counter-rotated with ½ rotation for each rotation of the needle cylinder, so that the two knitting needles **35**, **36** knit 1½ meshes at each rotation of the needle cylinder, that is in two rotations of the needle cylinder, the needles form three complete meshes. The arc of movement of the needle hooks which can be determined in the same manner as in the above described embodiments, shows that in this embodiment single covers are inter-knitted, in which needle **35** receives its thread in one rotation from the thread guide **37**, and in the second rotation from the thread guide **38**, while needle **36** receives at the same time the thread from the thread guide **39** in the first revolution and from the thread guide **40** in the second revolution. In the additional revolutions, the action is repeated. As can be seen from Fig. 21, four inter-knitted single covers are formed. The ratio plus one of the number of rotations between the cam cylinder and the needle cylinder is, in this embodiment, equal to 3/2. The numerator of this improper fraction shows that each needle is lifted three times for making meshes, while the needle cylinder makes two revolutions as indicated in the denominator. The number of knitting needles in the needle cylinder as well as the number of the locally rigid thread guide lifters can again be determined as in the embodiments of Figs. 15–18. Since four covers are produced and only one needle is present in the cam cylinder, the number of needles added to the "$n$" times number of needle lifters in the cam cylinder equals 6, that is there are present six locally rigid thread guides which must be mounted on those points where the knitting needles attain their highest position.

In the embodiments shown, the cam cylinder always makes a counter-revolution movement from that of the needle cylinder. To knit, however, by machines designed for knitting cables of the largest diameter, also cables of smaller diameter, the opposite effect can be attained, that the cam cylinder can be given a rotating movement in the same direction as the needle cylinder and in corresponding proportion in order to diminish the cam high points.

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