Feb. 3, 1959 H. S. BURDETT 2,871,684

CIRCULAR KNITTING MACHINES

Filed Dec. 19, 1955 4 Sheets-Sheet 1

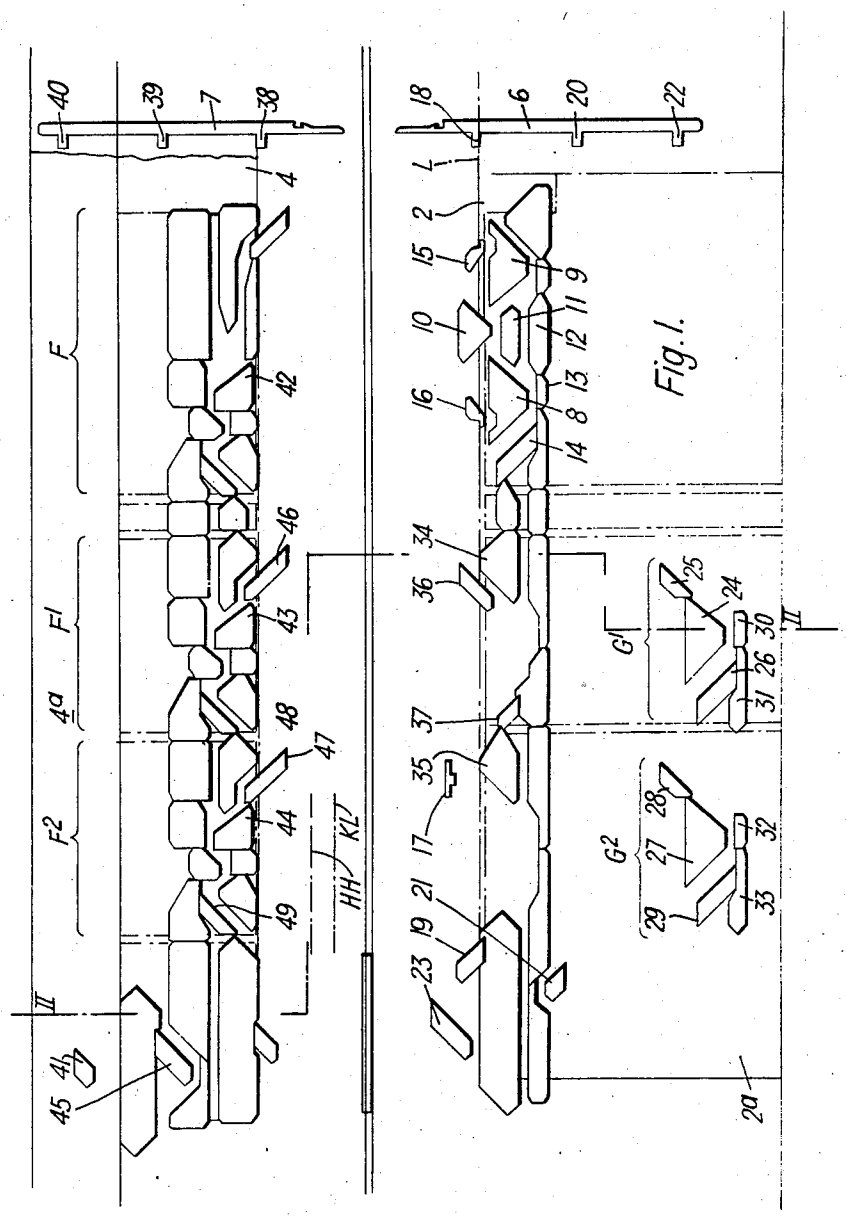


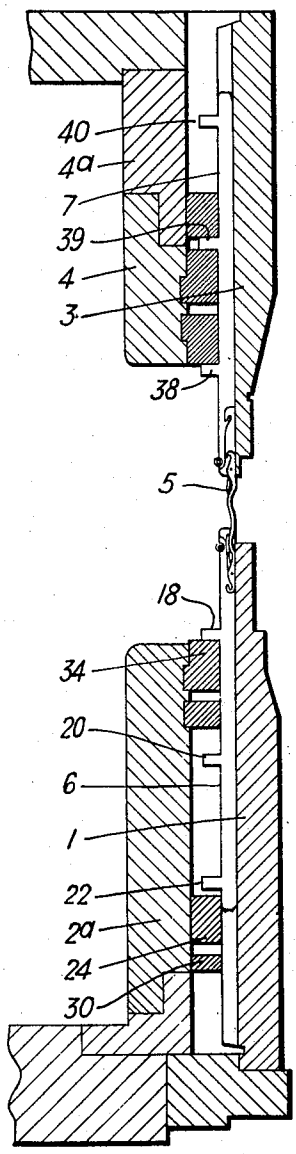
Fig. 1.

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Fig. 2.



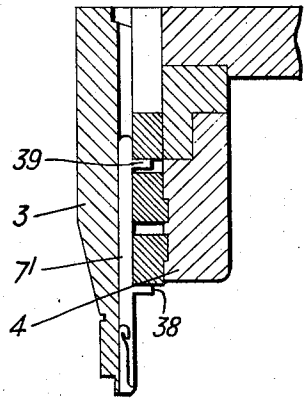
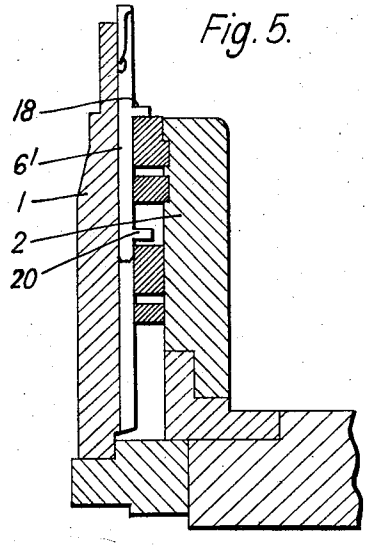


Fig. 5.

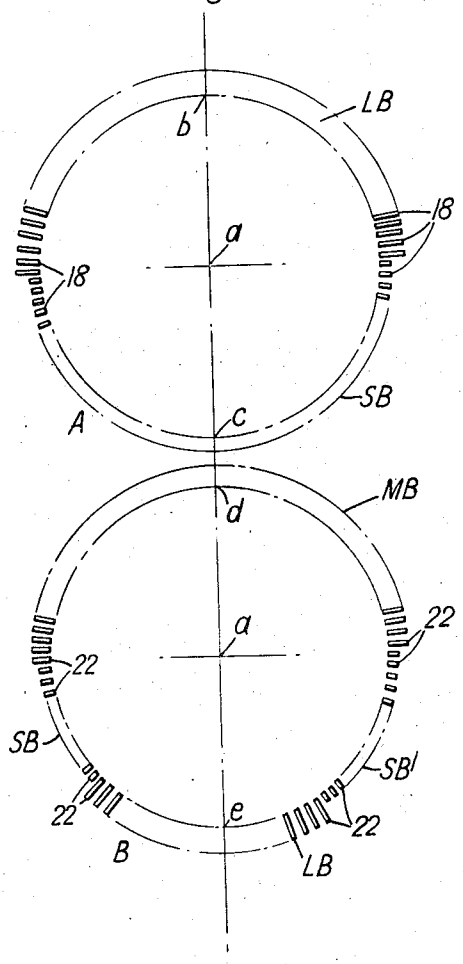


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Fig. 3.



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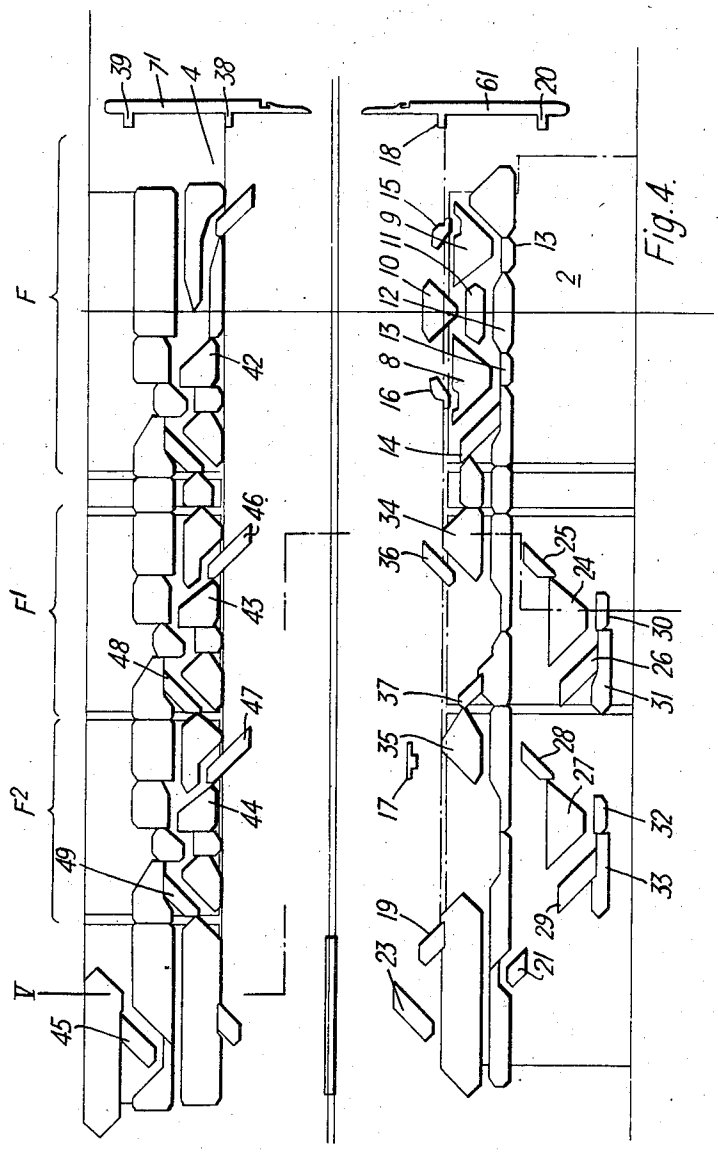


Fig. 4.

United States Patent Office 2,871,684 Patented Feb. 3, 1959

2,871,684

CIRCULAR KNITTING MACHINES

Henry Sidney Burdett, Knighton, England, assignor to G. Stibbe & Co. Limited, Leicester, England, a British company

Application December 19, 1955, Serial No. 554,018

Claims priority, application Great Britain December 30, 1954

7 Claims. (Cl. 66—14)

This invention appertains to circular knitting machines of the kind equipped with picker mechanisms for automatically effecting longitudinal displacement of needles whereby predetermined needles are systematically moved either to a knitting or to a non-knitting position, according to requirements.

The invention is primarily intended for application to circular knitting machines adapted to operate with oscillatory as well as with rotary motion and furnished with narrowing and widening pickers for the production of tubular knitted fabric with pouches.

In this regard the invention is principally applicable to single as well as to double cylinder seamless hosiery, i. e. hose or half hose, machines wherein narrowing and widening pickers are used for the production of heel and toe pouches, automatically, during oscillatory knitting.

A picker mechanism on a seamless hosiery machine can, of course, also be used for producing split-foot hosiery.

Moreover, for a reason shortly to be explained, the invention is more especially concerned with circular knitting machines of relatively small diameters, although there is no limitation in this respect.

In a circular knitting machine of the kind concerned, the universally or otherwise suitably articulated pickers are usually arranged for action upon knitting butts provided on the needles, or on the needle-actuating sliders or jacks, as the case may be. To enable the picker mechanism in such a machine to effect a required selection or selections of the needles, it is necessary to provide knitting butts of different lengths and to arrange these butts in a predetermined set-out which it is not possible to vary. Thus, for instance, and as well known to those acquainted with the knitting art, the needles in a circular seamless hose or half hose machine are customarily arranged in two substantially semi-circular groups, viz. the instep and the heel and toe needles, and to facilitate movement of the instep needles to a non-knitting position and to enable the narrowing and widening pickers to perform their function during the knitting of a heel or toe pouch, the instep and the heel and toe needles, or the associated jacks or sliders, as the case may be, are provided with long butts for the instep needles or their associated jacks or sliders and short or short and medium butts for the heel and toe needles—this particular set-out of the butts being incapable of variation. For this reason, the possibilities of selective manipulation of the needles and hence the knitting and patterning ranges of a machine of the kind herein referred to are limited.

Moreover, the fact that the pickers and their holders or brackets are located closely adjacent to the knitting cam system, or the appropriate knitting cam system, of the machine has naturally restricted the space available around the machine for the bolt and other cams. This restriction, in the case of a machine of comparatively small diameter, has heretofore been responsible for limiting the number of feeders (knitting stations) it was

possible to provide. In this connection, for example, the existence of the narrowing and widening pickers in a circular seamless hose or half hose machine having a needle cylinder or cylinders of as small as say, 3½" diameter, has heretofore made it difficult, if not impossible, to provide more than two feeders.

One object of the present invention, therefore, is to enhance the possibilities of selective manipulation of the needles, and hence increase the knitting and patterning ranges of a circular knitting machine of the kind herein referred to notwithstanding the existence of the picker mechanism in close proximity to the knitting cam system as aforesaid.

Another object of the invention is to enable a circular seamless hose or half hose machine of relatively small diameter to be readily equipped with three feeders.

In a circular knitting machine according to this invention there is a main feeder and an auxiliary feeder or feeders, and normal knitting butts of the needles, or of the associated jacks or sliders, are arranged to be acted upon by the cams of the main feeder and also by the pickers of the picker mechanism in conformity with known practice, the machine being characterised in that at least some of the cams of the or each auxiliary feeder are spaced from and clear of the cam system incorporating the main feeder cams and are arranged for action upon a set of needle, jack or slider butts separate and spaced axially from said normal knitting butts.

Thus, the additional butts spaced from the normal knitting butts are quite separate and distinct, thereby enabling said additional butts without upsetting the invariable set-out of the knitting butts acted upon by the pickers, to be of two or more varying lengths and to be arranged in contrasting groups or panels or interspersed in any pre-arranged set-out capable of being varied from time to time, according to knitting and patterning requirements.

The present invention is, therefore, distinguished from that disclosed in the specification of my Patent No. 2,759,342, in that, firstly, the picker mechanism is located in its conventional position closely adjacent to the knitting cam system including the cams at the main feeder, instead of being spaced axially from and clear of such system, and secondly, the additional butts separate and correspondingly spaced axially from the knitting butts are not acted upon by the pickers but by knitting cams of an auxiliary feeder or feeders. In other words, the problem of restricted space arising from the presence of the pickers is solved according to the present invention by separating at least some of the knitting cams of the auxiliary feeder or feeders from, and placing them at a lower level than, those of the main feeder, and by providing the needles, or associated jacks or sliders, with additional butts to be acted upon by the cams at the or each auxiliary feeder.

In one embodiment of the invention applied to a circular seamless hose or half hose machine of the superimposed rotary needle cylinder type, the additional butts are provided on the bottom needle-actuating sliders below and spaced clear of the transfer butts, the relevant cams of the or each auxiliary feeder being correspondingly spaced well beneath the horizontal zone of the cam system incorporating the cams of the main feeder and adjacent to which the pickers are provided.

According to a modification of this arrangement, however, the third, i. e. lower, butt on each bottom slider is dispensed with, and the aforesaid cams of the or each auxiliary feeder are arranged to act on the transfer butts. To enable this to be done, the said cams of the or each auxiliary feeder, although spaced clearly below the cam system incorporating the main feeder

cams are nevertheless at a higher level than in the first described embodiment.

In order that the invention may be more clearly understood and readily carried into practical effect, specific examples thereof embodied in a circular seamless hose or half hose machine of the superimposed rotary needle cylinder type will now be described with reference to the accompanying drawings, wherein,

Figure 1 is a developed layout of the top and bottom cam systems of such a machine as seen from the insides of the cam boxes, this figure illustrating one example of the invention and including side views of representative top and bottom needle-actuating sliders provided for use in conjunction with said system.

Figure 2 is a vertical sectional view taken on the line 11—11 of Figure 1, showing part of the head of the machine.

Figures 3A and 3B are diagrams illustrating the respective layouts of the normal knitting butts and the lower, i. e. additional butts on the bottom sliders.

Figure 4 is a view somewhat similar to Figure 1 showing a developed layout of top and bottom cam systems modified to suit the case where the third butt on each bottom slider is dispensed with, and the appropriate cams of the auxiliary feeders are arranged to act on the transfer butts of these sliders, and

Figure 5 is a vertical sectional view taken on the line V—V of Figure 3.

Like parts are designated by similar reference characters throughout the drawings.

Referring to Figure 2, it will be seen that the machine illustrated includes a bottom or plain rotary needle cylinder 1, surrounded by a stationary bottom cam box 2, a superimposed top or rib rotary needle cylinder 3 similarly surrounded by a stationary top cam box 4, double-ended needles such as 5 for operation in said cylinders, and bottom and top sliders 6 and 7 respectively for actuating the needles and transferring the same from one cylinder to the other, according to knitting requirements.

The double axially opposed needle cylinders 1 and 3 in the example illustrated in Figures 1 and 2 are of small diameter, e. g. in the order of 3½" or thereabouts, and the machine is equipped with three feeders, viz, a main feeder F and two auxiliary feeders F′ and F². In the cam system located within and carried by the bottom cam box 2 there are provided, at the main feeder F, the customary "legging" of forward stitch cam 8, the "heeling" or reverse switch cam 9, a centre guard cam 10, various other guard cams such as 11, 12 and 13 and a reverse welt cam 14 of the withdrawable bolt type all shown in Figure 1. In this machine the picker mechanism comprises two narrowing pickers 15 and 16 which are located immediately above the legging and heeling stitch cams 8 and 9 at the main feeder F, and a single widening picker 17 located at a slightly higher level than the narrowing pickers and at the back of the machine, i. e. nearly 180° from the centre guard cam 10. The pickers are thus arranged in the conventional way and they are adapted to function during oscillatory knitting in the usual manner. In this regard, each needle-actuating slider 6 is furnished with an upper, i. e. normal knitting, butt 18. Of the circular series of such normal knitting butts 18 substantially half are long as indicated at LB in Figure 3A, whilst the remander are short (see SB in the same figure). These two lengths of butts serve to differentiate the instep sliders from the heel and toe sliders, and the set-out of the normal knitting butts 18 cannot be varied. The narrowing pickers 15 and 16 elevate appropriate short butts of the group SB and so raise needles of the heel and toe group to the non-knitting level HH customarily known as "heeling height," and the widening picker 17 acts to depress such butts and lower again previously raised heel and toe needles.

The bottom cam system (at the same general level of the aforementioned knitting cams at the main feeder F) includes a movable "½-lift" cam 19 of the bolt type adapted, when appropriately adjusted, to act on the long normal knitting butts 18 of the group LB of the bottom sliders 6 for the purpose of raising the corresponding needles 5 of the instep group to the heeling height HH. Whenever such a division of the needles is effected preparatory to knitting a heel or a toe pouch, the short knitting butts 18 of the group SB are permitted to remain at a lower level L with the corresponding, i. e. the heel and toe, needles positioned at the knitting level KL (see Figure 1).

Each needle-actuating slider 6 in the bottom needle cylinder 1 is also furnished with an intermediate or transfer butt 20 arranged to be acted upon by the customary bottom transfer cam 21 for use in the transference of needles from the bottom cylinder 1 to the top cylinder 3, and, in accordance with the present invention, with a lower (additional) butt 22. The additional slider butts 22 are, therefore, located beneath the transfer butts 20 and are thereby well spaced axially from the upper (normal knitting) butts 18. The said additional butts may be of two or more different lengths arranged, as previously mentioned, in contrasting groups or panels or interspersed in any desired set-out capable of variation from time to time. Thus, the additional butts may be long, medium or short, or any combination of these lengths. A typical set-out of the additional butts 22 is illustrated in Figure 3B wherein it will be seen that the two separated groups of such butts represented by the arcuate portions LB and MB are long and of medium length respectively, whereas the butts of the intervening smaller groups indicated at SB and SB′ are short. Although, for convenience, the lay-outs of butts in Figures 3A and B have been separated it will, of course, be appreciated that, on the machine, these sets of butts 18 and 22 are disposed one above the other in suitably spaced horizontal planes. The central axis of the machine is indicated at *a* in both of the figures, and to show the correct relationship of the knitting butts 18 with respect to the additional slider butts 22, a chain line has been drawn on Figures 3A and B, it being understood that, in practice, the points *b* and *d* and the points *c* and *e* on this line respectively coincide.

The ½-lift cam 19 is also used, when suitably set, for action on upper slider butts 18 for the purpose of elevating bottom sliders 6 to bring their transfer butts 20 into the range of the bottom transfer cam 21 during transference of needles from the bottom to the top cylinder. A levelling cam 23, located near to the ½-lift cam 19 (at the same level as the widening picker 17), is provided for action on upper butts 18 to depress the bottom sliders 6 to the low level after such a transference of needles. The slider 6 shown at the right-hand side of Figure 1 is at the said low level.

In the specific example now being described, the bottom cam box shell 2 is made longer than usual and in the lower portion 2*a* of the said box there are provided, at a substantially lower level than the legging and heeling stitch cams 8 and 9 at the main feeder F, two circumferentially spaced groups G′ and G² of cams arranged so as to be capable of acting upon the additional bottom slider butts 22. These two groups G′ and G² constitute the knitting cams of the first and second auxiliary feeders F′ and F² respectively. Thus, the group G′ at the first auxiliary feeder F′ comprises a stitch cam 24, an adjoining feed cam 25 of the withdrawable bolt type for determining whether or not raised needles shall knit at that feeder, and an adjoining upthrow cam 26 also of the withdrawable bolt type. Similarly, the group G² at the second auxiliary feeder F² comprises a stitch cam 27, a feed cam 28 and an upthrow cam 29. Each of the two upthrow cams 26 and 29 may also function as a reverse welt cam and, in any event, has its upper surface at such

a level that when the lower edge of the bottom butt **22** of any slider **6** is resting thereon, the corresponding needle will be at clearing height. Suitable guard cams such as **30**, **31** and **32**, **33** are provided beneath the stitch and upthrow cams at each of the two auxiliary feeders F′ and F². For raising sliders **6** to an extent sufficient to bring their lower butts **22** into the range of the feed cams **25** and **28** at the auxiliary feeders F′ and F² there are provided at a high level (in fact, in the same horizontal zone as that occupied by the legging and heeling cams **8** and **9** at the main feeder F) clearing cams **34** and **35** respectively for action on the upper butts **18** of said sliders.

The aforementioned bolt cams at the two auxiliary feeders F′ and F², separated axially from the cams in the higher zone are arranged to be operated and controlled from an auxiliay control unit at the back of the machine.

Immediately above the clearing cam **34** at the first auxiliary feeder F′ there is provided, for action on the upper slider butts **18**, a separating course (press-off) feed cam **36** of the bolt type, whilst at a location cicumferentially spaced from this cam and nearer to the back of the machine there is a separating course upthrow cam **37** also for action on the upper butts **18**. Thus, for pressing-off needles in the bottom cylinder **1** only whilst needles in the top cylinder **3** retain their loops at the first auxiliary feeder F′ for the purpose of producing a separating course, between one article and the next of a string, no yarn is introduced at the said feeder and the following setting of the relevant cams is adopted: the feed cams **25** and **28** and the upthrow cams **26** and **29** at the two auxiliary feeders are withdrawn and the separating course feed cam **36** is pushed into action. As a consequence, the upper butts **18** on the bottom sliders **6** are depressed by the separating course feed cam **36** to such an extent as to enable their lower (additional) butts **22** to be landed upon and taken down by the stitch cam **24** of the first auxiliary feeder F′ so that old loops are cast off the needles actuated by said sliders. Immediately following this action, the upper butts **18** of the same sliders are acted upon by the separating course upthrow cam **37**.

By providing in the top cylinder **3** sliders **7** of the same form as the bottom sliders **6**, that is to say top sliders with knitting butts **38**, transfer butts **39** and additional butts **40** of different lengths, it is possible to use the said additional butts in conjunction with an additional transfer cam **41** (Figure 1) provided in an upper extension *4a* of the top cam box **4**, thereby increasing the needle transferring possibilities of the machine.

The stitch cams at the three feeders F, F′ and F² in the top cam box **4** are indicated at **42**, **43** and **44** respectively. The numeral **45** indicates the main transfer cam in the top cam box for use in transferring needles from the top cylinder **3** to the bottom cylinder **1**. Also, provided in the top cam box at the two auxiliary feeders F′ and F² are feed cams **46** and **47** and welt cams **48** and **49** which four cams are all of the bolt type and all controlled from the aforementioned auxiliary control unit at the back of the machine.

The example just described with reference to Figures 1, 2 and 3, may be modified by dispensing with the lower butts **22** on the bottom sliders and arranging for the feed cams **25** and **28**, the stitch cams **24** and **27**, and the upthrow cams **26** and **29** of the two auxiliary feeders F′ and F² to act instead on the transfer butts **20**. Thus, in this modification which is depicted in Figures 4 and 5, the said cams at the auxiliary feeders require to be located at a somewhat higher lever than the corresponding cams in the first described example. Otherwise, the two arrangements function in precisely the same way, although where the third set of butts **22** is dispensed with the patterning possibilities of the machine are naturally reduced in so far as the transfer butts are then required to function for two purposes.

I claim:

1. In a circular seamless hose knitting machine adapted to operate with oscillatory as well as with rotary motion, in combination, a bottom needle cylinder, a superimposed top needle cylinder, a series of double-ended needles operating in said cylinders, sliders in both cylinders for actuating the needles and transferring same from one cylinder to the other according to knitting requirements, each of the sliders in the bottom cylinder being provided with a normal upper knitting butt, an intermediate transfer butt and a lower additional butt, a substantially semi-circular series of the normal knitting butts on the bottom sliders being long and the remainder shorter, and the aforesaid lower additional butts being of at least two lengths interspersed in a pre-arranged set-out capable of being varied without upsetting the set-out of the normal knitting butts, a cam box surrounding the bottom cylinder, a group of knitting cams including legging and heeling stitch cams which are provided in the cam box at a main feeder and are arranged to act on said normal knitting butts, narrowing and widening pickers acting on pre-arranged ones of the said normal knitting butts and by means of which the number of needles in action for knitting in the bottom cylinder is systematically varied during the production of heel and toe pouches by oscillatory motion, and, in an extension of the cam box at a lower level than and spaced axially clear of the group of cams at the main feeder, two circumferentially spaced further groups of knitting cams at first and second auxiliary feeders respectively, the cams of these further groups being arranged for action upon the lower additional slider butts.

2. A combination according to claim 1, wherein the said group of knitting cams at each auxiliary feeder comprises a stitch cam, an adjoining feed cam of the withdrawable bolt type for determining whether or not raised needles shall knit at that feeder, and an adjoining upthrow cam also of the withdrawable bolt type.

3. A combination according to claim 2, wherein the said upthrow cam at each auxiliary feeder has its upper surface at such a level that when the lower edge of the lower additional butt of any bottom slider is resting thereon, the corresponding needle will be at clearing height.

4. A combination according to claim 2, wherein the upthrow cams at the auxiliary feeders are also capable of functioning as reverse welt cams.

5. In a three-feeder circular seamless hose knitting machine adapted to operate with oscillatory as well as with rotary motion, in combination, a bottom needle cylinder, a superimposed top needle cylinder, a series of double-ended needles operating in said cylinders, sliders in both cylinders for actuating the needles and transferring same from one cylinder to the other according to knitting requirement, each of the sliders in the bottom cylinder being provided with a normal upper knitting butt, an intermediate transfer butt and a lower additional butt, a substantially semi-circular series of the normal knitting butts on the bottom sliders being long and the remainder shorter, and the aforesaid lower additional butts being of at least two lengths interspersed in a pre-arranged set-out capable of being varied without upsetting the set-out of the normal knitting butts, a cam box surrounding the bottom cylinder, a group of knitting cams including legging and heeling stitch cams which are provided in the cam box at a main feeder and are arranged to act on said normal knitting butts, narrowing and widening pickers acting on pre-arranged ones of the said normal knitting butts and by means of which the number of needles in action for knitting in the bottom cylinder is systematically varied during the production of heel and toe pouches by oscillatory motion, two circumferentially spaced further groups of knitting cams at first and second auxiliary feed-

ers respectively, the cams of these further groups being provided in a downwardly directed extension of the cam box at a lower level than, and spaced axially clear of, the group of cams at the main feeder and being arranged for action upon the lower additional slider butts, the said further group of knitting cams at each auxiliary feeder comprising a stitch cam, an adjoining feed cam of the withdrawable bolt type for determining whether or not raised needles shall knit at that feeder and an adjoining upthrow cam also of the withdrawable bolt type, and, at the same higher level as that occupied by the legging and heeling stitch cams at the main feeder, clearing cams for action on the upper, i. e. normal knitting, butts of the bottom sliders for the purpose of raising selected sliders to an extent sufficient to bring the lower additional butts thereof into the range of the feed cams at the auxiliary feeders.

6. A combination according to claim 5, wherein there is provided above the clearing cam at the first auxiliary feeder, for action on the normal knitting butts of the bottom sliders, a separating course (press-off) feed cam of the bolt type, whilst at a location spaced from this cam there is a separating course upthrow cam for action on the same butts.

7. In a circular seamless hose knitting machine adapted to operate with oscillatory as well as with rotary motion, in combination, a bottom needle cylinder, a superimposed top needle cylinder, a series of double-ended needles operating in said cylinders, sliders in both cylinders for actuating the needles and transferring same from one cylinder to the other according to knitting requirements, each of the sliders in the bottom cylinder being provided with a normal upper knitting butt, an intermediate transfer butt and a lower additional butt, a substantially semi-circular series of the normal knitting butts on the bottom sliders being long and the remainder shorter, and the aforesaid lower additional butts being of at least two lengths interspersed in a pre-arranged set-out capable of

being varied without upsetting the set-out of the normal knitting butts, a cam box surrounding the bottom cylinder, knitting cams which are provided in said box at a main feeder and are arranged to act on said normal knitting butts, narrowing and widening pickers acting on pre-arranged ones of the said normal knitting butts and by means of which the number of needles in action for knitting in the bottom cylinder is systematically varied during the production of heel and toe pouches by oscillatory motion, transfer cam means in the bottom cam box arranged for action upon the intermediate transfer butts on the bottom sliders during transference of needles upwards from the bottom cylinder to the top cylinder, further knitting cams in the aforesaid cam box at at least one auxiliary feeder, the last mentioned cams being spaced axially clear of and below the main feeder cams for action upon the additional bottom slider butts, the top cylinder sliders being of the same form as the bottom sliders, i. e. having knitting butts, transfer butts and additional butts, a cam box surrounding the top cylinder and having an upper extension, transfer cam means in the said top cam box for action on the transfer butts of the top sliders during transference of needles downwards from the top cylinder to the bottom cylinder, and, in the upper extension of the top cam box, an additional transfer cam for action upon the additional butts of the said top sliders.

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