CIRCULAR KNITTING MACHINE
Otto Griesbach, Southingen, Allgau, Germany, assignor to Bayerische Berg-, Hütten- und Salzwerke A. G., Munich, Germany
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The present invention relates to circular knitting machines, and more particularly to a circular knitting machine provided with pattern drums arranged coaxial with the needle cylinders.

In known circular knitting machines the pattern drum is arranged horizontally and at a right angle to the axis of the needle cylinder. This arrangement necessitates a great distance between the pattern drum on one hand, and the cam cylinders, and the auxiliary devices for controlling the knitting operation on the other hand. The motion transmitting devices employed in the known knitting machine, and particularly in circular double-cylinder knitting machines, consist of a plurality of levers, connecting rods, ball joints, etc., which complicated apparatus makes access to the machine difficult and is subject to disturbances during operation. Moreover, the combined play of the many required joints and bearings makes it impossible to produce exactly corresponding control movements which causes disturbances in the operation of the machine.

It is the object of the present invention to overcome the disadvantages of the known arrangement of the pattern drum, and to provide in a circular knitting machine, pattern drum means arranged coaxial with the axis of the needle cylinder.

It is another object of the present invention to provide in a circular double-cylinder knitting machine a pattern drum for each of the needle cylinders arranged coaxial with the associated needle cylinder.

With these objects in view the present invention mainly consists in a circular knitting machine comprising, in combination, a pair of needle cylinders, a plurality of actuating means for controlling knitting operations, a pair of pattern drums arranged coaxial with the needle cylinders of the machine, and motion transmitting means actuated by the pattern drum and operating the actuating means.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with its additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a sectional view of a knitting machine according to the present invention;
Fig. 2 is a plan view of the machine;
Fig. 3 is a cross sectional view on line III—III in Fig. 1;
Fig. 4 is a plan view of a detail; and
Fig. 5 is a cross sectional view on line V—V in Fig. 1.

Referring now to the drawings, the two needle cylinders 1 and 2 are driven by gears 3 and 4. The needle cylinders 1 and 2 are supported on bearings 5 and 6 and are guided by the cylindrical supports 7 and 8. Bearing 5 is supported by the upper supporting plate 9, and bearing 6 on the lower supporting plate 10. Screws 11 and 12 are fastened to the cylindrical supports 7 and 8 of the upper supporting plate 9 and 10, the latter being spaced from each other by a spacing unit comprising two parallel rings 15 and 16 and at least three supporting columns 17 which are equally spaced from each other.

Due to the symmetrical arrangement of the supporting columns 17 exact coincidence of the axes of the two needle cylinders 1 and 2 is assured whereby a perfect cooperation of the needles is obtained. Fixedly secured to the supporting plates 9 and 10 are the cam cylinders 20 and 21 which are provided with actuating means 18 and 19 respectively. The supporting plates 9 and 10, the spacing units 15, 16 and 17, the cylindrical supports 7 and 8 and the cam cylinders 20 and 21 constitute a rigid stationary supporting means.

The cam cylinders 20 and 21, or more particularly the actuating means 18 and 19, are associated with pattern drums 22 and 23 respectively which are rotatably mounted on extensions of the respective guiding cylinders 1 and 2. The two control members or pattern drums 22 and 23 are positively connected for rotation at the same rotary speed by transmission means comprising two spur gears 24, 26 fixedly secured to the pattern drums 22 and 23 respectively, and two pinions 25 and 27 which are inter engaged to a shaft 28 which extends parallel to the axis of the needle cylinder. Shaft 28 is turnably supported in members 29, 30 which are fixed by screws 13, 14 on rings 15, 16. A crank handle 36 is fixedly secured to one end of the shaft 28 permitting manual rotation of the same.

For rotating the pattern drums by a motor, drive means are provided which include a toothed wheel 33 fixedly secured to the lower pattern drum 22 preferably directly under the spur gear 26, and a reciprocating push rod 31 provided at its end with a pivoted pawl 32 urged by a spring 35 into engagement with the teeth of the toothed wheel 33, as can be best seen from Fig. 5. The push rod 31 and thereby the rotation of the toothed wheel 33 and of the pattern drums 22 and 23 is controlled by a counting chain, not shown, through a pivotally mounted lever 34 which, when turned by the counting chain, pivots the pawl 32 against the action of spring 35. According to the actuation by the counting chain the lever 34 turns the pawl 32 either to an inoperative position in which it does not engage the toothed wheel 33 during the reciprocating movement of the push rod 31 so that the pattern drums do not move, or turns the pawl 32 to an intermediate position in which it engages adjacent teeth during consecutive reciprocating movements of the push rod 31 so that the toothed wheel 33 is turned only for the distance of one tooth. If the lever 34 is not actuated by the counting chain, the pawl 32 passes over two teeth during the rearward movement of the push rod 31 so that during the forward movement the toothed wheel 33 is shifted about an angle corresponding to two teeth. Consequently the pattern drums have two rotary speeds and rotate twice as fast when the lever 34 is in inoperative position.

The pattern drums may be also rotated by the handle 36 which effects rotation of the shaft 28 and the gears 24, 25, 26 and 27.

While the push rod 31 acts directly on the lower pattern drum 23, the upper pattern drum 22 is driven by means of the transmission 26, 27, 28, 25 and 24, so that preferably means are provided for assuring exact shifting of the upper pattern drum 22 regardless of a play in the transmission. For this purpose a notched wheel 37 is fixedly secured to the outer and upper end of the pattern drum 22 and provided with the perimeter thereof with notches 38 as can be best seen from Fig. 2. The notches 38 are spaced from each other the same distance as the teeth of the toothed wheel 33. Whenever the pattern drum 22 is shifted, the detent means 39 jumps into one of the notches 38 so that the position of the pattern drum
22 corresponds exactly to the position of the pattern drum 23. The supporting rod 40 of the detent 33 is mounted in a guiding means 42 slideable in radial direction. Guiding means 42 is fixed secured to the cover plate 41. The rod 40 is inwardly urged by the spring 43 so that the detent 33 is permanently urged to slide with its knife edge along the perimeter of the notched wheel 37 during rotation, and to engage the notches 38.

Each pattern drum comprises a plurality of cam segments 45 which are held by means of threaded bolts 46 extending parallel to the axis of the needle cylinder. Each two bolts 46 pass through a pile of cam segments 45 securing the same against rotation. The segments 45 of the pattern drum 22 are clamped between the ring 47 and the notched wheel 37, and the segments of the pattern drum 23 are clamped between the ring 48 and the toothed wheel 33. For exchanging a single cam segment only the associated bolts 46 are removed, and it is not necessary to dismount the pattern drums. This arrangement is a considerable improvement over the prior art which employed radially extending screws having flush heads located on the perimeter of the segments, interrupting the smooth surface of the cam segments and disturbing the smooth sliding of the cam followers. Each group of three cam segments 45 is engaged on one cam ring which controls one actuating means 18, 19 of the corresponding cam cylinder 20 or 21, respectively, or an auxiliary device located close to the respective pattern drum.

Thereby it becomes possible to transfer the actuating impulses of the pattern drums over the shortest possible distance. For the actuation of the actuating means 18, for instance, a shaft 49 is arranged parallel to the axis of the needle cylinders and provided with a cam follower lever 50 sliding on a cam ring of the pattern drum 22, and an actuating lever 51 cooperating with the actuating means 18. While the actuating lever 51 is fixedly secured to the shaft 49, the cam follower lever 50 is turnably mounted on the shaft, and may be adjusted by the adjusting screw 52 which is mounted in the arm 53 of the ring 54, the latter fixedly secured to the shaft 49. The cam follower lever 50 is adjusted to engage on a cam ring 45 of the pattern drum 22 while the lever 51 engages the actuating means 18 so that an actuation without any play is assured.

The shaft 49 is rotatably mounted in a tube 55 which is clamped in a conical bore 58 of the supporting plate 9 by means of a clamping bush 56 which is tightened by the screw 57. Mounting of the shaft 49 in this manner has the advantage that it may be axially shifted together with the tube 25 after the clamping bush 56 has been loosened, whereby the cam follower lever 50 can be exactly adjusted to be exactly positioned on the associated cam ring 45 of a pattern drum. Similar motion transmitting means are provided for operating other actuating means, or auxiliary devices of the machine.

The sinkers associated with the upper needle cylinder are controlled by the uppermost cam ring of the drum 22. An arm 60 is secured to a member 61 which is slideable in a guiding means 62 secured to the cover plate 41. The bracket 64 is fixedly secured to the guiding means 62 and supports a knee lever 65 which is pivotally mounted on a pin 63. When member 61 is shifted, the knee lever 65 is pivoted and presses the sinker actuating rod 66 downward. The rod 66 is returned to its upper position by the spring 67, and is operatively connected to the sinkers for operating the same. It will be noted that the connection between the segment ring and the sinker actuating rod 66 is very short so that undesirable play is avoided.

It is obvious that auxiliary devices needed for carrying out a knitting operation may be connected by motion transmitting means to a cam ring 45 of the nearest pattern drum so as to be operated by the same.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of circular knitting machine differing from the types described above.

While the invention has been described and claimed as embodied in circular double-cylinder knitting machine provided with pattern drums arranged coaxial with the needle cylinders, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed is:

1. In a circular knitting machine including two coaxially arranged needle cylinders, in combination, supporting means including cylindrical supports for the needle cylinders; two pattern drums rotatably mounted on said cylindrical supports coaxial with the needle cylinders; each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation; two spur gears, each spur gear fixedly secured to one of said pattern drums coaxial with the same; a shaft rotatably mounted in said supporting means and extending parallel to the axis of said pattern drums; two pinions fixedly secured to said shaft, each pinion meshing with one of said spur gears whereby said pattern drums are positively connected for rotating at the same speed; and drive means rotating one of said pattern drums.

2. In a circular knitting machine including two coaxially arranged needle cylinders, in combination, supporting means including cylindrical supports for the needle cylinders; two pattern drums rotatably mounted on said cylindrical supports coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation; two spur gears, each spur gear fixedly secured to one of said pattern drums coaxial with the same; a shaft rotatably mounted in said supporting means and extending parallel to the axis of said pattern drums; two pinions fixedly secured to said shaft, each pinion meshing with one of said spur gears whereby said pattern drums are positively connected for rotating at the same speed; and drive means rotating one of said pattern drums.

3. In a circular knitting machine including two coaxially arranged needle cylinders, in combination, supporting means including cylindrical supports for the needle cylinders; two pattern drums rotatably mounted on said cylindrical supports coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation; two spur gears, each spur gear fixedly secured to one of said pattern drums coaxial with the same; a shaft rotatably mounted in said supporting means and extending parallel to the axis of said pattern drums; two pinions fixedly secured to said shaft, each pinion meshing with one of said spur gears whereby said pattern drums are positively connected for rotating at the same speed; and drive means rotating one of said pattern drums.

4. In a circular knitting machine including two coaxially arranged needle cylinders, in combination, supporting means; two pattern drums rotatably mounted on said supporting means coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation; transmission means positively connecting said pattern drums for rotating together at the same speed; a toothed wheel fixedly secured to one of said pattern drums coaxial therewith; and a reciprocating push rod engaging said toothed wheel during reciprocating movement in one direction for rotating the same.

5. In a circular knitting machine including two coaxially arranged needle cylinders, in combination, supporting means including cylindrical supports for the needle
cylinders; two pattern drums rotatably mounted on said cylindrical supports coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation; two spur gears, each spur gear fixedly secured to one of said pattern drums coaxial with the same; a shaft rotatably mounted in said supporting means and extending parallel to the axis of said pattern drums; two pinions fixedly secured to said shaft, each pinion meshing with one of said spur gears whereby said pattern drums are positively connected for rotating at the same speed; a toothed wheel fixedly secured to one of said pattern drums adjacent to the corresponding spur gear; and a reciprocating push rod engaging said toothed wheel during reciprocating movement in one direction for rotating the same.

6. In a circular knitting machine, in combination, supporting means; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said supporting means; two pattern drums rotatably mounted on said supporting means coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders, and a plurality of motion transmitting means, each motion transmitting means including a shaft rotatably mounted in said supporting means extending parallel to the axis of said pattern drums, a cam follower lever secured to one end of said shaft engaging one of said pattern drums, and a lever fixedly secured to the other end of said shaft and engaging one of said actuating means so that knitting operations are controlled by said pattern drums.

7. In a circular knitting machine, in combination, supporting means; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said supporting means; two pattern drums rotatably mounted on said supporting means coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders; and a plurality of motion transmitting means, each motion transmitting means including a shaft rotatably mounted in said supporting means extending parallel to the axis of said pattern drums, a cam follower lever secured to one end of said shaft engaging one of said pattern drums, and a lever fixedly secured to the other end of said shaft and engaging one of said actuating means so that knitting operations are controlled by said pattern drums.

8. In a circular knitting machine, in combination, supporting means; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said supporting means; two pattern drums rotatably mounted on said supporting means coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders; and a plurality of motion transmitting means, each motion transmitting means including a shaft rotatably mounted in said supporting means orthogonal to the axis of said pattern drums, a cam follower lever secured to one end of said shaft engaging one of said pattern drums, and a lever fixedly secured to the other end of said shaft and engaging one of said actuating means so that knitting operations are controlled by said pattern drums.

9. In a circular knitting machine, in combination, supporting means; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said supporting means; two pattern drums rotatably mounted on said supporting means coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders; and a plurality of motion transmitting means, each motion transmitting means including a shaft rotatably mounted in said supporting means orthogonal to the axis of said pattern drums, a cam follower lever secured to one end of said shaft engaging one of said pattern drums, and a lever fixedly secured to the other end of said shaft and engaging one of said actuating means so that knitting operations are controlled by said pattern drums.

10. In a knitting machine including two coaxial vertical needle cylinders, in combination, two horizontally spaced supporting plates; two spaced horizontal rings fixedly secured to said supporting plates; at least three vertical supporting columns located intermediate said rings and being secured to the same; two cylindrical supports, each cylindrical support secured to one of said annular supporting plates and adapted to guide the needle cylinders; and two pattern drums rotatably mounted on said supporting cylinders coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation.

11. In a knitting machine including two coaxial vertical needle cylinders, in combination, two horizontal spaced supporting plates; two spaced horizontal rings fixedly secured to said supporting plates; at least three vertical supporting columns located intermediate said rings and being secured to the same; two cylindrical supports, each cylindrical support secured to one of said annular supporting plates and adapted to guide the needle cylinders; and two pattern drums rotatably mounted on said supporting cylinders coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and adapted to control a knitting operation; a plurality of actuating means for controlling knitting operations; and a plurality of motion transmitting means, each motion transmitting means engaging at one end thereof one of said pattern drums and at the other end thereof one of said actuating means.

12. In a knitting machine including two coaxial vertical needle cylinders, in combination, two horizontal spaced supporting plates; two spaced horizontal rings fixedly secured to said supporting plates; at least three vertical supporting columns located intermediate said rings and being secured to the same; two cylindrical supports, each cylindrical support secured to one of said annular supporting plates and adapted to guide the needle cylinders; two pattern drums rotatably mounted on said supporting cylinders coaxial with the needle cylinders, each pattern drum associated with one of the needle cylinders and including a plurality of cam rings; a plurality of actuating means for controlling knitting operations; and a plurality of motion transmitting means, each motion transmitting means engaging at one end thereof one of said cam rings of one of said pattern drums and at the other end thereof one of said actuating means.

13. In a circular knitting machine, in combination, supporting means; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said supporting means; two pattern drums rotatably mounted on said supporting means coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders and adapted to control knitting operations; a plurality of pattern drums for rotation together; a plurality of motion transmitting means, each motion transmitting means engaging at one end thereof one of said pattern drums and at the other end thereof one of said actuating means so that knitting operations are controlled by said pattern drums; a toothed wheel coaxial with one of said pattern drums and adapted to rotate the same; and reciprocating push rod means engaging said toothed wheel during movement thereof in one direction for rotating the same and said pattern drums.
14. In a circular knitting machine, in combination, supporting means including cylindrical supports for the needle cylinders; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said supporting means; two pattern drums rotatably mounted on said cylindrical supports coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders; and a plurality of motion transmitting means, each motion transmitting means engaging at one end thereof one of said pattern drums, and at the other end thereof one of said actuating means so that knitting operations are controlled by said pattern drums.

15. In a circular knitting machine, in combination, supporting means including cylindrical supports for the needle cylinders; two coaxially arranged needle cylinders mounted on said supporting means; a plurality of actuating means for controlling knitting operations mounted on said cylindrical supports; two pattern drums rotatably mounted on said supporting means coaxial with said needle cylinders, each pattern drum associated with one of said needle cylinders; a plurality of motion transmitting means, each motion transmitting means engaging at one end thereof one of said pattern drums, and at the other end thereof one of said actuating means so that knitting operations are controlled by said pattern drums; and sinker actuating means reciprocally mounted on said supporting means and engaging at one end thereof one of said motion transmitting means so as to be operated by the same.

16. In a circular knitting machine including two coaxially arranged needle cylinders, in combination, two spaced supports, each support being located adjacent one of the needle cylinders; two control members, each control member rotatably mounted on one of said supports coaxial with the needle cylinders and adjacent one of the needle cylinders, each control member being associated with the adjacent needle cylinder and adapted to control the knitting operation; a toothed wheel coaxial with one of said control members and secured to the same for rotation therewith; and a reciprocating push rod engaging said toothed wheel during movement thereof in one direction for rotating said toothed wheel and said control member; and means connecting said control members for rotation.

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