Jan. 25, 1955 E. BELLINI 2,700,285

MOTION CONTROL DEVICE FOR KNITTING MACHINES

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Fig. 1.

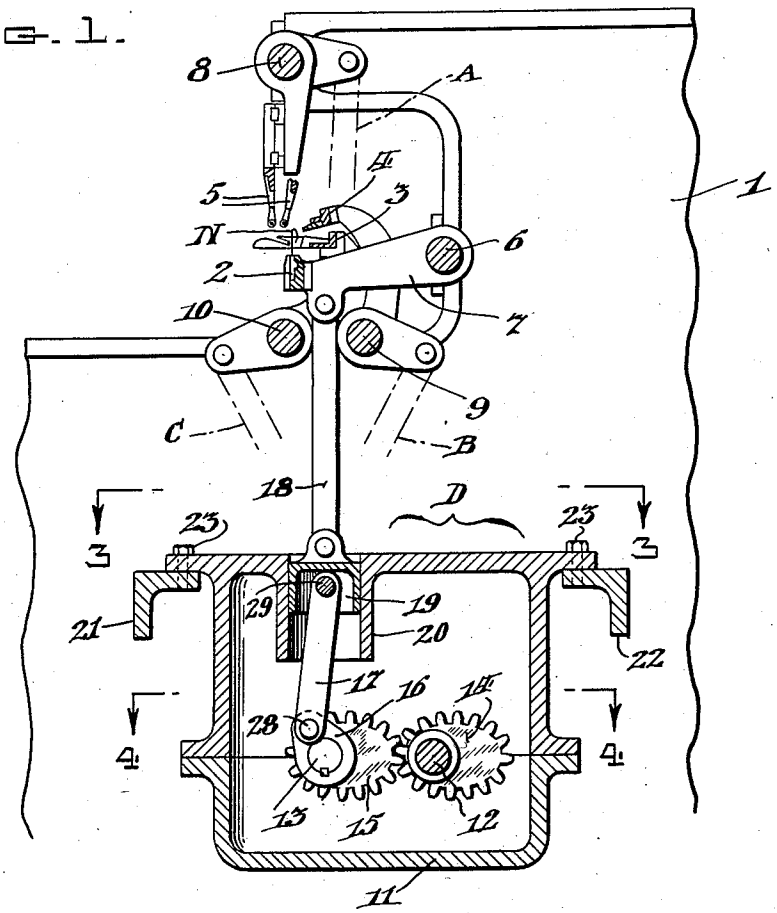

Fig. 2.

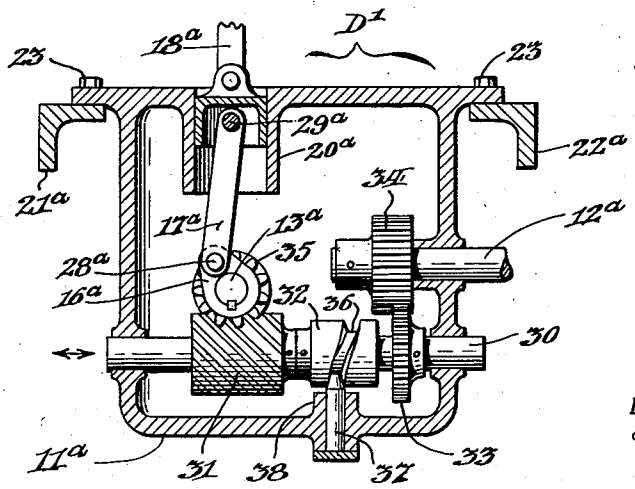

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FIG. 3.

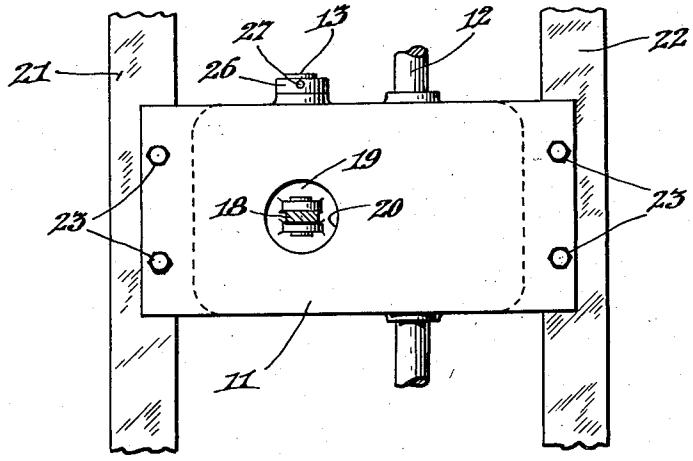
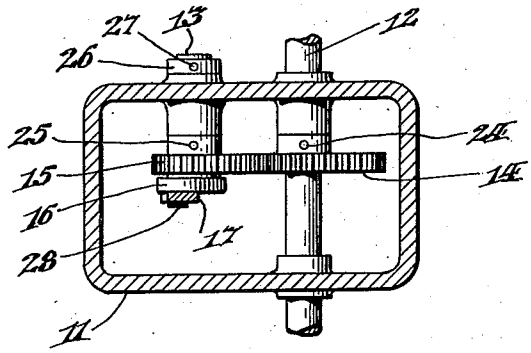


FIG. 4.



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MOTION CONTROL DEVICE FOR KNITTING MACHINES

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11 Claims. (Cl. 66—86)

This invention relates to knitting machines and the like, in general, having machine means arranged to be operated in successive variable speed cycles of the same order, such as needle bars, sinker bars, etc., and more particularly concerns a device adapted for cooperative embodiment in such a machine to effect positive and precise operation of said machine means, especially when the machine is operated at high speed.

In knitting machines, such as warp or tricot knitting machines, full-fashioned hosiery knitting machines, etc., certain stitch or loop forming elements, such as the needles, sinkers, etc., are moved through successive variable speed operating cycles of the same order. Such operating cycles have heretofore been imparted by cam devices, belt or bar connected eccentrics, parallel eccentrics operating at different but related and individually constant speeds, etc. It has been found in practice that these prior art devices do not function satisfactorily when the machine speed is increased beyond a certain point, since the cyclic variable speed motion imparted by these devices becomes more or less inaccurate at such higher speeds, due to vibration, slippage, play, excessive wear, or other causes, with the result that imperfections appear in the loop formation of the fabric produced by the machine.

One object of my invention is to provide a novel device of the type indicated, which can be readily embodied in knitting machines and the like, to overcome the mentioned and other difficulties.

Another object is to provide such a device which has certain structural and functional features of advantage over the similar devices of the prior art.

A further object is to provide such a device which functions in positive and precise manner during all operating speeds of the machine.

An additional object is to provide such a device comprising directly-meshed gear means adapted to effect a more positive drive and motion control action for the said cyclically operable machine means, than possible with the similar prior art devices.

Another object is to provide such a device in which special gear means and other parts are arranged to cooperate in novel manner.

It is also an object to provide such a device comprising certain gears arranged in rotational and sliding cooperation relative to each other.

Another object is to provide such a device comprising helical as well as spur gears, in combination with means adapted to impart a certain sliding movement to said gears, so as to effect a certain variable speed movement in novel manner.

Another feature of the invention resides in the provision of such a device having elliptical gears.

A further object is to provide such a device in which the said gears are cooperatively associated in novel manner with a motion translating unit of the type including a piston-like slide member, or crosshead, and a cylindrical guide member.

Another feature of the invention resides in combining with a machine having means arranged to be operated in successive variable speed cycles of the same order, a novel device including certain elements or parts arranged in cooperative relationship, such as a driving shaft having uniform rotary motion, a driven shaft, speed change gear means secured in cooperative relation on said shafts and arranged so that the uniform rotary motion of the driving shaft will effect variable speed rotary motion of the driven shaft, a motion translating member, means operatively connecting said member with the driven shaft, and means operatively connecting said member with the cyclically operable machine means.

With these and other objects in view, which will become more apparent from the following detailed description of the practical and illustrative embodiments of my improvements shown in the accompanying drawings, the invention comprises the novel device, elements, features of construction and arrangement of parts in cooperative relationship, as more particularly defined by the hereto appended claims.

In the drawings:

Figure 1 is a partial vertical cross-sectional view of a warp knitting machine embodying one form of my novel device.

Fig. 2 is a vertical cross-sectional view of a modified form of the device of my invention.

Fig. 3 is a plan sectional view, taken substantially as indicated by the arrows 3—3 on Fig. 1, and

Fig. 4 is a plan sectional view taken substantially as indicated by the arrows 4—4 in Fig. 1.

In general, the novel device of my invention is applicable to machines, such as knitting machines of all types, wherein certain elements, or mechanisms, such as the loop forming elements or mechanisms, are actuated at different speeds at different times during the operating or knitting cycle. It is to be understood, therefore, that the application of my invention to a warp or tricot knitting machine, as herein shown, is by way of illustration, or exemplification, of only one practical application thereof. Those skilled in this art will readily recognize further uses for my novel improvements in other machines for a similar purpose.

It will be helpful to an understanding of my invention to first briefly consider some of the more important aspects and features thereof, so that these may be kept in mind during the subsequent reading of the detailed description of the practical and illustrative embodiments shown in the accompanying drawings.

Accordingly, it is pointed out that in standard or conventional knitting machines, such as warp or tricot knitting machines, full-fashioned hosiery knitting machines, etc., the knitted fabric produced by the machine, consists of rows or courses of loops that are successively formed in interconnected order by certain yarn feeding and loop forming elements, such as needles, sinkers, yarn guides, etc., a multiplicity of which are usually mounted in adjacently arranged spaced relation on a support, or bar, and operated in unison so as to produce one course of loops after another until the fabric is completed. In warp or tricot knitting machines, the needles, sinkers, yarn guides, etc., must be actuated at different speeds at different times in order that the loop forming, or knitting cycle, be carried out precisely and efficiently. Comparatively slight variations in the proper operating cycles of such elements will cause undesirable imperfections to appear in the fabric knitted by the machine so that it is highly important that the timing and precise movement of these elements be maintained at all operating speeds of the machine. It has been found in practice that the operation of the indicated knitting machines cannot be increased beyond a certain point without the mentioned and other difficulties developing to a greater or lesser extent, due to the fact that the devices embodied in such machines for actuating the loop forming elements do not function in the precise manner required at such higher machine speed for the reasons previously pointed out.

The device of my invention is designed so that it can be readily embodied in machines for the purpose of precisely actuating said elements at all operating speeds of the machine and particularly at the higher machine operating speeds where the similar prior art actuating devices become structurally or functionally faulty, defective, or troublesome. I have found that by utilizing certain gear means in my novel actuating device, in cooperative combination with other means, steady and improved operating control is attained, with elimination of the detrimental slippage, vibration, and other undesirable characteristics of the similar prior art devices.

Referring now to the drawings, in which similar ref-

erence characters indicate similar parts, I have there shown my novel device embodied in a standard or conventional tricot or warp knitting machine comprising such usual and well-known parts as a frame 1, a needle bar 2, a sinker bar 3, a presser bar 4, yarn guide bars 5, a shaft 6, having secured thereto arms 7, on which are fixedly mounted the needle bar 2 that is provided with the usual number of adjacently arranged and spacedly mounted needles N. Shafts 8, 9 and 10 are provided and arranged in known manner for carrying and actuating respectively, the yarn guides 5, presser bar 4 and sinker bar 3.

One form of my novel actuating device is shown in Fig. 1. The said device is generally designated by the letter D, and, as illustrated, is mounted and arranged for operation of the needle bar 2 of the machine, in known manner in successive variable speed cycles, as heretofore.

The device D generally comprises a sectional casing or housing 11, a drive shaft 12, a driven shaft 13, a pair of similar elliptical gears 14 and 15, a crank member 16, connecting rods 17 and 18, and a motion translating member or crosshead 19, that is slidably mounted for vertical reciprocation in a cylindrical guide member 20, formed in the upper portion of the sectional housing 11.

The housing 11 may be supported on machine frame members 21 and 22 and suitably secured thereto as by bolts 23, and the shafts 12 and 13 are journaled in suitable bearings formed in the housing 11, as indicated in Fig. 1.

The elliptical gears 14 and 15 are fixedly secured in suitable manner to the shafts 12 and 13, as by pins 24 and 25, see Fig. 4. The change speed ratio of these gears is designed in accordance with usual gear practice, to provide the exact usual variable speed movement, or operating cycle, normally imparted to the needle bar 2, as heretofore, when the shaft 12 is rotated at a predetermined speed. In other words, when the shaft 12 is constantly rotated at said predetermined speed, the shaft 13 will be rotated so as to impart to the needle bar 2, the usual variable speed operating or knitting cycle in successive order, through the motion transmitting means comprising the crank member 16, connecting bar 17, motion translating member or crosshead 19, connecting rod 18 and vertically reciprocable arms 7.

The crank member 16 may be keyed to the shaft 13, as shown in Fig. 1, or otherwise suitably connected for united rotation with shaft 13 and gear 15, and the shaft 13 is maintained in position against axial movement by suitable means, such as a collar 26 secured to the outer end of the shaft 13 by a pin 27. A crank pin, or stud 28, is integrally formed with the crank member 16 and projects laterally therefrom for connection with the lower end of the rod or bar 17, the upper end of which is connected with the motion translating member or crosshead 19, by a pin 29.

If desired, my novel actuating device D can be similarly utilized to operate other parts, elements, or mechanisms of the knitting machine. For example, the yarn guides 5, the presser bar 4, or the sinker bar 3. This can be done by replacing the connecting bar 18 with one which establishes a connection between the motion transmitting member or crosshead 19, and the respective oscillating shaft with which the said yarn guides, presser bar, or sinker bar are operatively associated. In Fig. 1, such substitute connecting bars are indicated in dot-and-dash lines marked A, B, and C, respectively, shown in each instance pivotally connected with the end of an appropriate arm which is fixedly secured to the particular oscillating shaft of the said different knitting machine part. Of course, it is to be understood that appropriate change speed gears 14 and 15, are provided in the device D, designed as required in each instance in accordance with usual gear designing practice, so that the variable speed rotation of the driven shaft 13 is such as to properly operate the respective different machine parts in successive cycles as heretofore.

A modified form of my invention is shown in Fig. 2 of the drawings, which device is generally identified by the reference character D^1 and embodies certain parts or elements which are similar to those embodied in the device D. To avoid redundancy in the description of such similar parts, the latter are identified by similar reference characters in the modified device D^1, but have the exponent "*a*" added thereto for purposes of differentiation.

The modified device D^1 mainly differs from the first described form of my invention in that it embodies a different change speed gear arrangement between the driving shaft 12^a and the driven or crank shaft 13^a, as well as an intermediate shaft 30 which is mounted so as to be axially movable in both directions to a limited extent during operation of the device. The shaft 12^a is mounted for constant rotation in suitable bearing means formed in the housing 11^a, as indicated in Fig. 2, and has imparted thereto a uniform rotary motion by direct or indirect connection with a motor or some other machine means adapted to so operate the shaft 12^a at a predetermined speed. The intermediate shaft 30 is also suitably mounted in bearings formed in the housing 11^a for rotary as well as limited axial movement. The driven or crank shaft 13^a is mounted in substantially the same manner as the shaft 13 of the device D.

Secured to the intermediate shaft 30, for rotation therewith, is a helical gear 31, a cylindrical cam member 32, and a spur gear 3, which latter meshes with a wider spur gear 34, secured to the drive shaft 12^a for rotation therewith. The helical gear 31 is in mesh with a helical gear 35 fixedly secured to the driven shaft 13^a. The meshing spur gears 33 and 34, and the meshing helical gears 31 and 35 are, in each instance, designed and arranged in one-to-one motion transmitting ratio. The cam member 32 is provided with a cam groove 36 into which extends a freely rotating pin 37 that is mounted in an appropriate boss 38 formed in the housing 11^a, as clearly indicated in Fig. 2.

When the device D^1 is operated and the driving shaft 12^a rotated at a predetermined uniform rate of speed by suitable motivating means, the intermediate shaft 30 is likewise rotated at the same rate of speed as the shaft 12^a, since these shafts are operatively connected to each other by the directly meshing spur gears 33 and 34. Rotation of the intermediate shaft 30 will also effect axial reciprocating movement of the latter as determined by the circumferential cam groove 36 in the cam member 32, and freely rotating pin 37. Such simultaneous rotational and reciprocating movement of the intermediate shaft 30 will be transmitted by the helical gear 31, to the helical gear 35, in such manner as to cause variable speed rotation of the driven shaft 13^a, by reason of the fact that the one-to-one ratio of the rotational movement existing between the helical gears 31 and 35, is supplemented by the sliding movement between the teeth of these gears as the intermediate shaft 30 is reciprocated. In effect, the speed of the driven shaft 13^a will be increased as the intermediate shaft 30 moves in one direction, and decreased as the latter moves in the opposite direction. This increase and decrease in the rotational speed of the driven shaft 13^a takes place uniformly and as determined by the rate of shifting movement of the intermediate shaft 30, in turn determined by the shape of the circumferential cam groove of the cam member 32. During the axial movement of the intermediate shaft 30, the teeth of the spur gear 33 will slide along the teeth of the stationarily mounted spur gear 34, however, without any change in the one-to-one rotational speed ratio existent between the drive shaft 12^a and the intermediate shaft 30.

From the foregoing description of the change speed arrangement embodied in the device D^1, it will be apparent that the drive shaft 13^a can be rotated at a desired variable rate of speed, and that this movement can be transmitted through the connecting bar 18^a to the needle bar 2, or to the other loop forming elements of the machine above pointed out, as explained in connection with the description of the device D, in order that such respective loop forming element will operate as heretofore, to carry out its variable speed operating cycle in successive order. To effect a change in the rate of speed that the driven or crank shaft increases or decreases during its rotational cycle of operation, merely requires the substitution for the cam member 32, of a similar member having a cam groove thereof designed so as to bring about a particular axial reciprocating movement of the intermediate shaft 30 and a similar movement between the helical gears 31 and 35, as required to attain the desired speed increase and decrease in the cyclic rotational movement of the driven shaft 13^a.

Aside from the helical gears, there could be substituted a worm and worm wheel arrangement, the worm wheel being mounted on the driven shaft. Furthermore, instead of a driven or crank shaft, an eccentric can be inserted.

Of course, the novel improvements specifically shown and described, can be changed and modified in various

ways without departing from the invention herein disclosed, the scope of which is more particularly indicated by the hereto appended claims.

I claim:

1. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, and motion transmitting means connecting said driven shaft and said reciprocatively operable member.

2. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, and connecting means between said driven shaft and said reciprocatively operable member which connecting means is adapted to change the variant speed rotary motion of the driven shaft into an arcuate reciprocating motion.

3. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, and motion transmitting means including a piston-type device connecting said driven shaft and reciprocatively operable member.

4. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, gears operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, and motion transmitting means connecting said driven shaft and reciprocatively operable member.

5. A knitting apparatus of the character described comprising, loop forming means incluting a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, a device connected with said driven shaft for changing the variant speed rotary motion of the latter into a straight variant speed reciprocating motion, and means connecting said device and reciprocatively operable member.

6. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, a crank element on said driven shaft, a device connected with said crank element for changing the variant speed rotary motion of the crank element into a variant speed straight reciprocating motion, and means connecting said device and reciprocatively operable member.

7. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable member having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said reciprocatively operable member, a crank element on said driven shaft, a device connected with said crank element for changing the variant speed rotary motion of the crank element into a variant speed straight reciprocating motion, and a rigid link element connecting said device and reciprocatively operable member.

8. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable needle bar support having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, means operatively connecting said driven shaft with said drive shaft which means is adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said needle bar support, a crank element on said driven shaft, a device connected with said crank element for changing the variant speed rotary motion of the crank element into a variant speed straight reciprocating motion, and a rigid link element connecting said device and needle bar support.

9. A knitting apparatus of the character described comprising, loop forming means including a reciprocatively operable needle bar support having a variant speed movement cycle, a drive shaft having uniform rotary motion, a driven shaft, gears operatively connecting said driven shaft with said drive shaft which gears are adapted to effect rotation of said driven shaft in variant speed movement cycle conformity with said needle bar support, and motion transmitting means connecting said driven shaft and needle bar support.

10. In a warp knitting machine the combination with a reciprocatively operable needle bar support having a variant speed movement cycle, of a drive shaft having uniform rotary motion, a driven shaft, gears operatively connecting said driven shaft with said drive shaft which gears are adapted to effect rotation of said driven shaft in variant speed cycle conformity with said needle bar support, a crank element on said driven shaft, a piston-type device connected with said crank element for changing the variant speed rotary motion of the crank element into a variant speed straight reciprocating motion, and a rigid link element connecting said device and needle bar support.

11. In a warp knitting machine the combination with a reciprocatively operable needle bar support having a variant speed movement cycle, of a drive shaft having uniform rotary motion, a driven shaft, a pair of elliptical gears arranged to establish a variant speed connection between said drive shaft and driven shaft so as to effect rotation of said driven shaft in variant speed cycle conformity with said needle bar support, a crank element mounted on said driven shaft for rotation therewith, a piston-type device connected with said crank element for changing the variant speed rotary motion of the crank element into a straight variant speed reciprocating motion, and a rigid link element having one end thereof pivotally connected with said crank element and its other end pivotally connected with said needle bar support.

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