

# United States Patent

Townsend et al.

[15] 3,703,819

[45] Nov. 28, 1972

[54] CIRCULAR KNITTING MACHINES

[72] Inventors: Keith Gerald Townsend; David Arthur Harlow, both of Leicester, England

[73] Assignee: The Bentley Engineering Company Limited, Leicester, England

[22] Filed: April 20, 1970

[21] Appl. No.: 30,176

[30] Foreign Application Priority Data

April 26, 1969 Great Britain.....21,422/69

[52] U.S. Cl.....66/93, 66/108 R

[51] Int. Cl.....D04b 9/12, D04b 15/06

[58] Field of Search.....66/107, 108 R, 108 A, 9 R, 66/93

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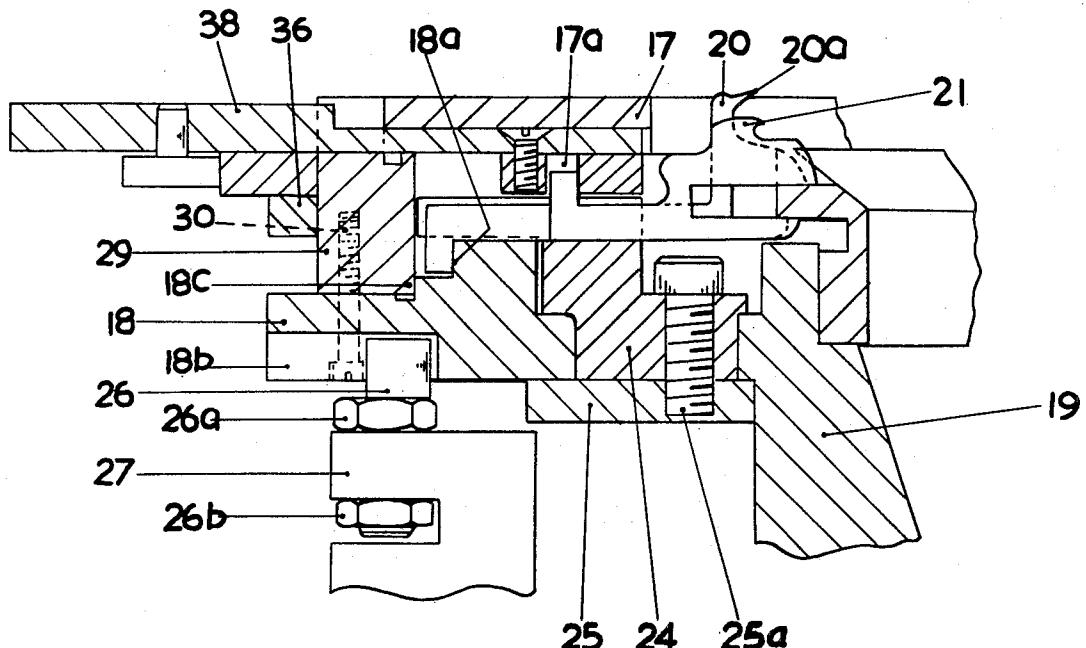
Primary Examiner—Wm. Carter Reynolds  
Attorney—Robert E. Burns and Emmanuel J. Lobato

[57]

ABSTRACT

A circular knitting machine having latch needles, sinkers and terry instruments is provided with a cam assembly having sinker operating cams and terry instrument cams mounted to permit relative adjustment between them to vary the relative timings of the sinker and terry instrument cams. In a machine having multiple knitting stations and sinker and terry instrument cams at the different stations, these are respectively on different cam plates which are relatively adjustable, with the sinker cams engaging butts which project the opposite way to the terry instrument butts.

4 Claims, 8 Drawing Figures



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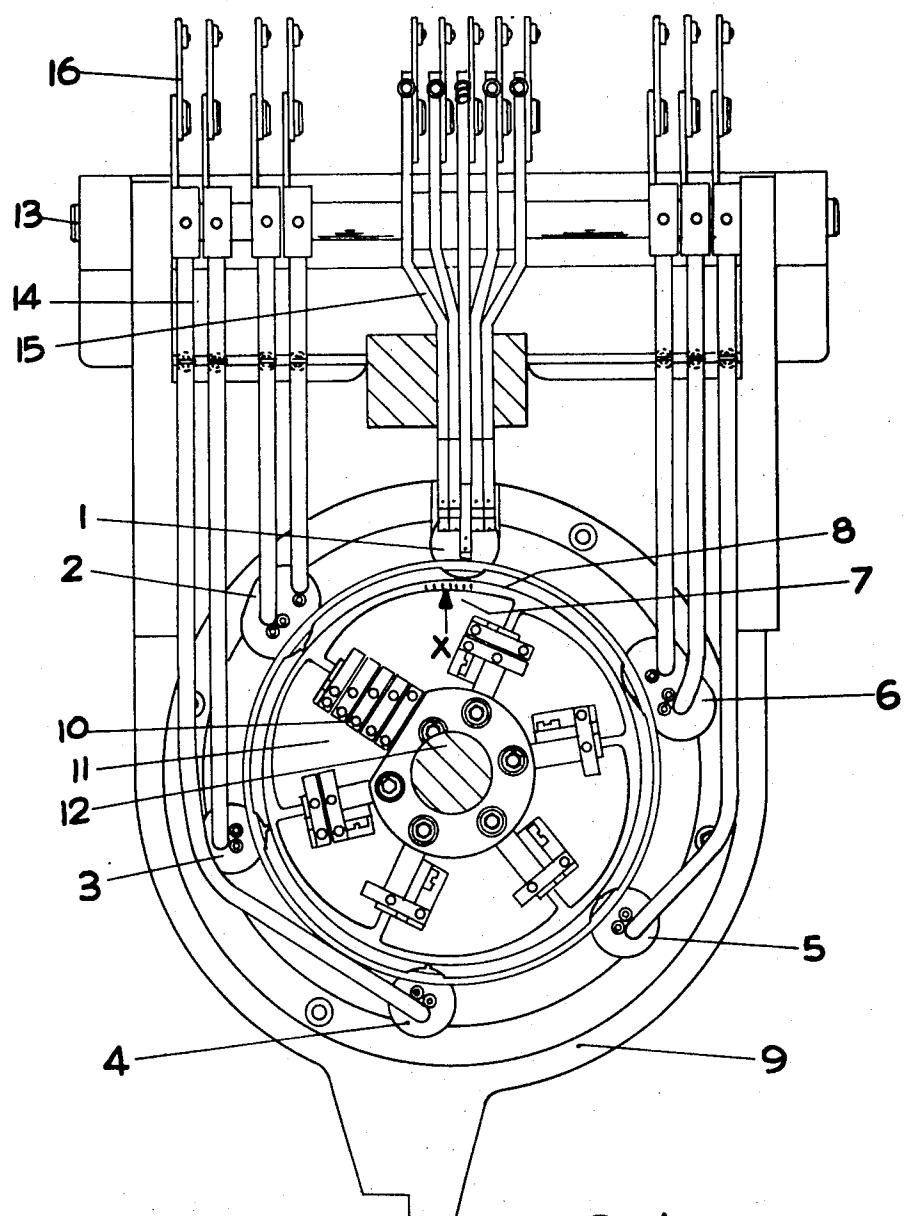


FIG. 1.

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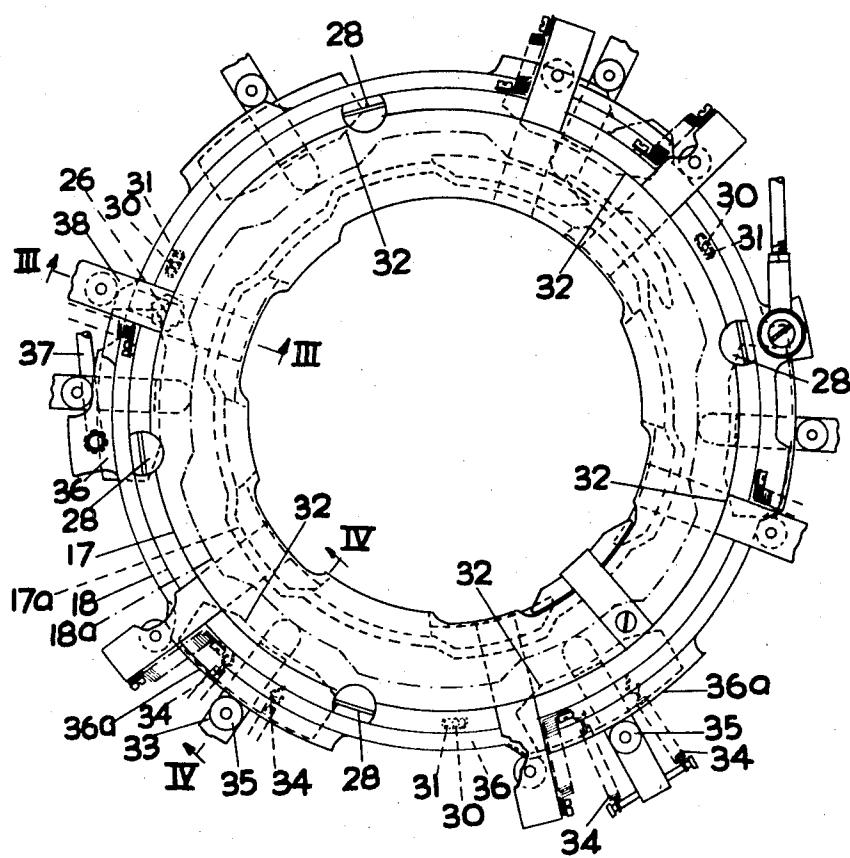


FIG. 2

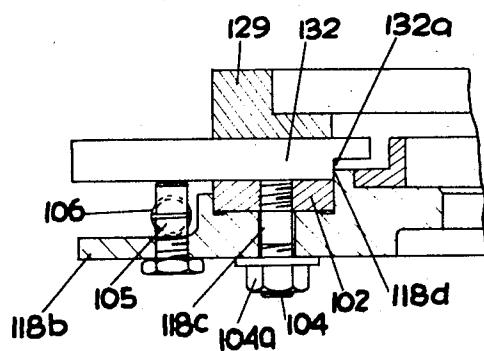


FIG. 8

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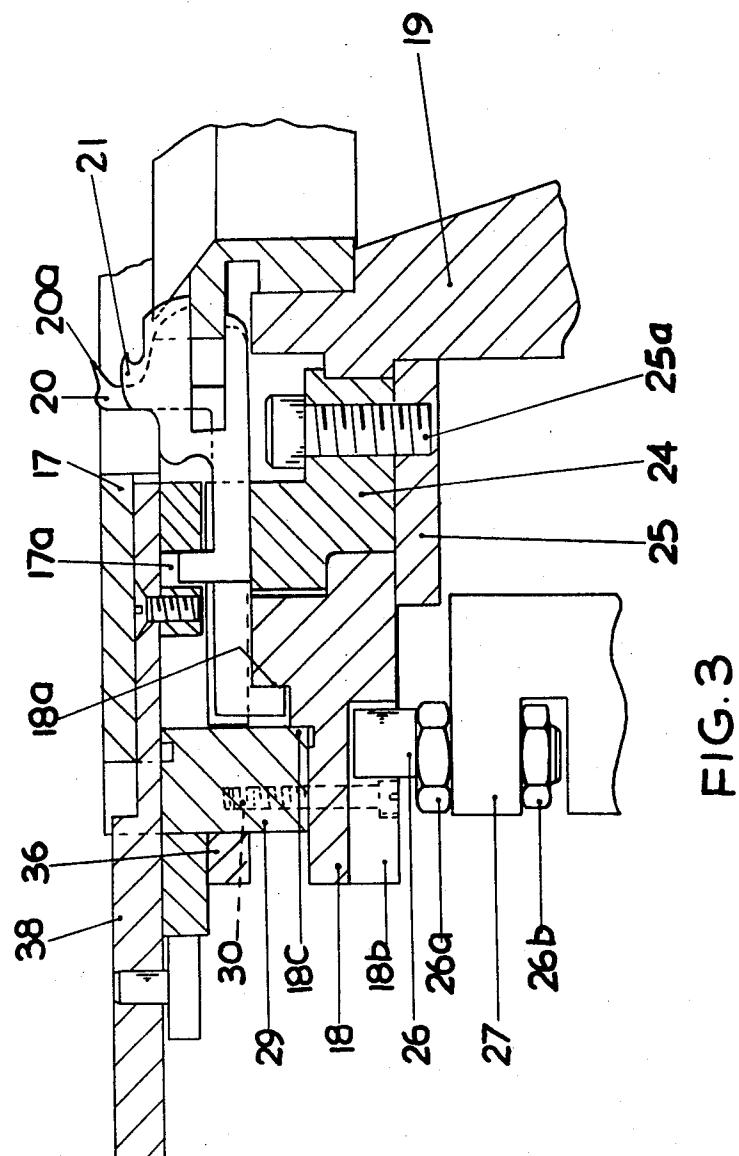


FIG. 3

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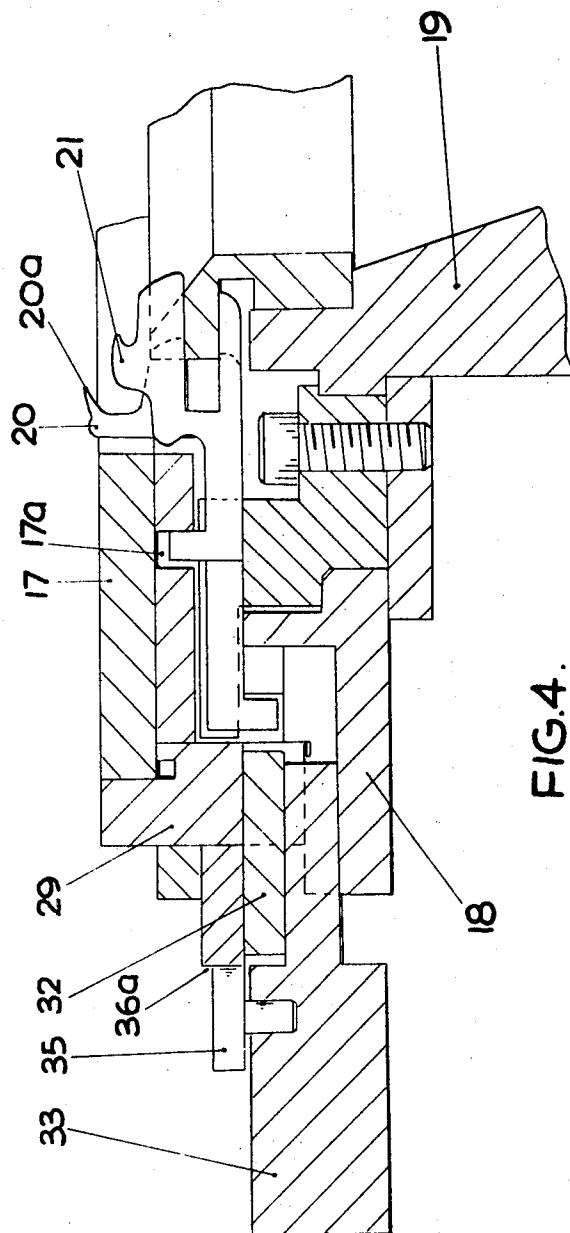
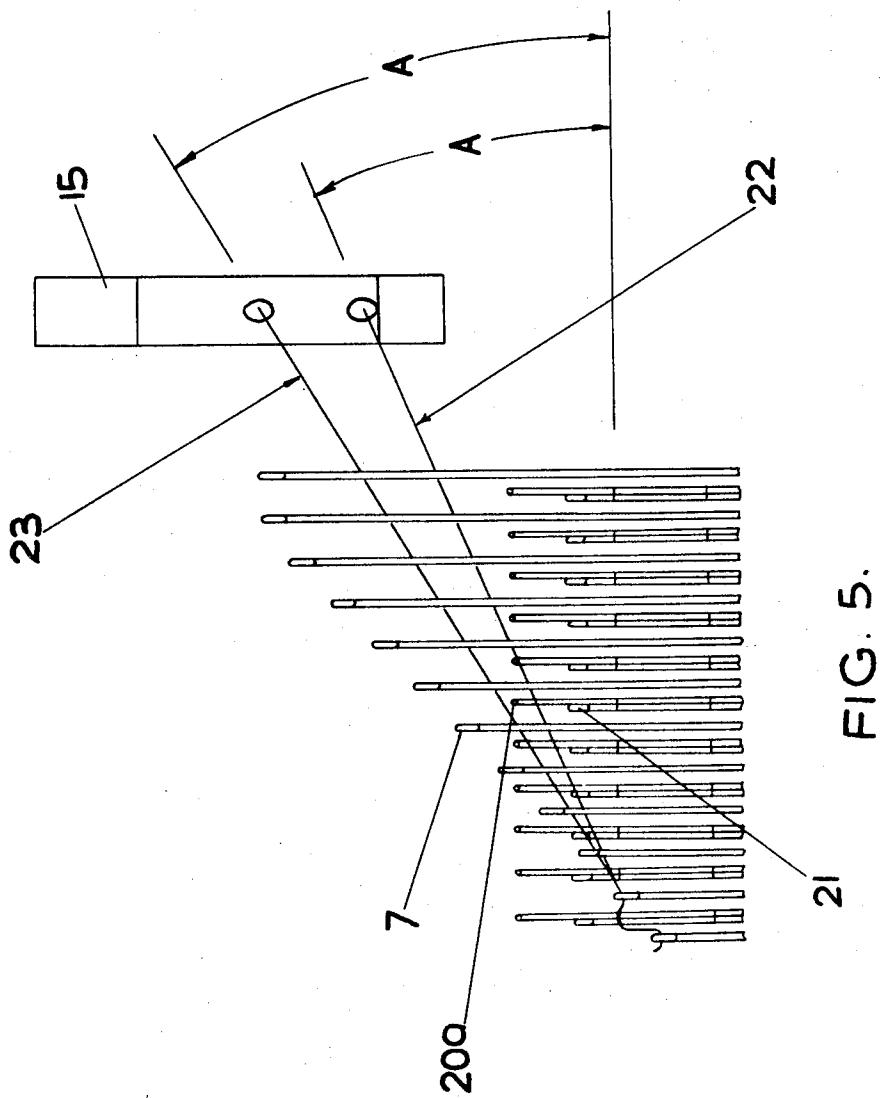


FIG. 4.

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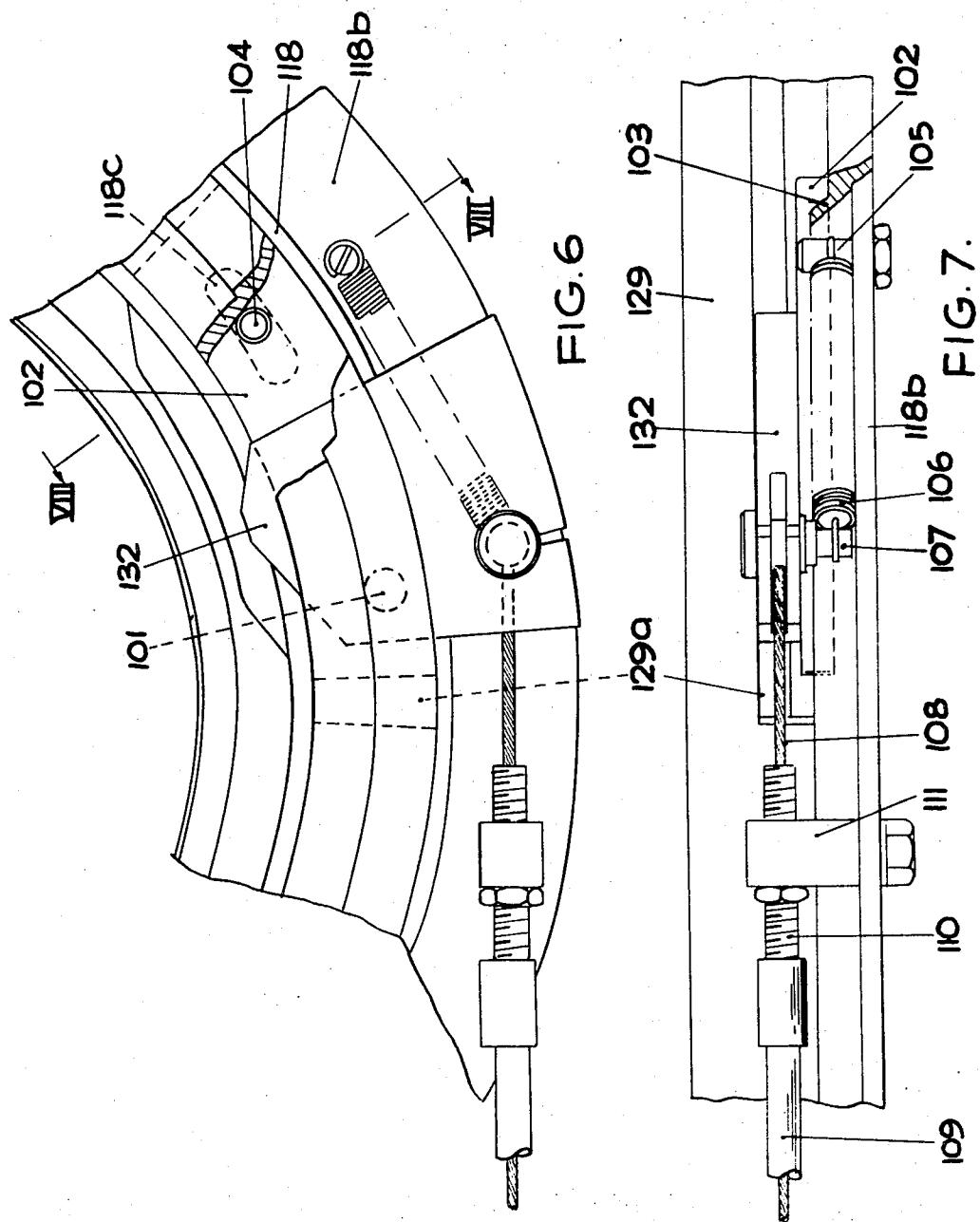
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## CIRCULAR KNITTING MACHINES

This invention is for improvements in circular knitting machines and is concerned more particularly with machines of the single cylinder type equipped with latch needles and sinkers and additional sinker-like elements provided for knitting elongated (terry) loops in certain areas of tubular fabric such as knitted footwear. The invention seeks to provide means whereby adequate control of the additional instruments can be secured in a convenient and effective manner.

In a circular knitting machine of known form having sinkers and sinker-like instruments (hereinafter termed "terry instruments") for knitting fabric having elongated (terry) loops the terry instruments and sinkers are mounted in pairs in the tricks of a sinker ring and are operated by butts respectively on the sinkers and terry instruments which are guided in a cam track which is largely common to the sinkers and terry instruments. By making the respective butts of different lengths and providing cams of different heights it is possible to operate the two types of instruments to some extent independently of one another. This known arrangement has the disadvantage that although the instruments are capable of independent movement it is not possible to adjust the timing of the movement of the terry instruments relatively to those of the sinkers. Adjustments of timing have been found to be necessary so that the relative positions of the sinkers and terry instruments can be adjusted to suit different types of yarn which may be used and the need for such adjustment is more especially needed in a machine having a substantial number of (for example, six) knitting stations spaced apart around a needle cylinder of small diameter. With a multi-feed machine (i.e. a machine having a substantial number of knitting stations) the distance from the feeders to the knitting points is relatively short and yarns from the two feeders at a knitting station supplying the ground yarn and the terry yarn respectively, converge to the knitting point in a distance which is shorter than that on a machine having a single knitting station or only a small number of knitting stations. Consequently the position at which the terry instruments (on which loops of the terry yarn are drawn) must enter between the converging terry and ground yarns can be very critical. To deal with such a condition it is necessary to provide for accurate timing of the relative movements of the sinkers and terry instruments and the invention seeks to provide a form of construction wherein this is conveniently made possible.

In accordance with the invention in one aspect there is provided in a circular knitting machine equipped with latch needles, sinkers and terry instruments, a cam arrangement organized for control of the sinkers and terry instruments independently of one another with cams acting on the sinkers and other cams acting on the terry instruments to control their movements, such sinker cams and terry instrument cams being arranged to permit relative adjustment between them to vary the relative timing of the operative movements of said sinkers and instruments. Thus the facility is provided for making adjustments whereby the terry instruments can be made to enter between the converging ground yarn and terry yarn.

The provision just referred to is conveniently applied at each knitting station of a machine having a plurality

or multiplicity of feeding stations spaced apart around the needle cylinder.

In accordance with a further aspect the invention provided in a circular knitting machine equipped with 5 latch needles, sinkers and terry instruments, a cam system comprising cams acting on butts projecting one way from the sinkers, and other cams acting on butts projecting in the opposite way from the terry instruments. The two sets of cams related to the sinkers and 10 instruments respectively are arranged to provide for the appropriate relative timings of the movements of the sinkers and terry instruments and can be made adjustable to vary such timing in a required manner.

15 In a convenient arrangement the sinkers are outside sinkers which have butts co-operating with cams in a cam arrangement carried by a sinker ring and said sinker ring may also support cams at a different position to cooperate with butts on the terry instruments.

20 The cams for operating the terry instruments may be mounted so as to be adjustable as a whole by turning about the cylinder axis relatively to the sinker cams. Further the several terry instrument operating cams may be adjustable relatively to one another about said axis.

25 Certain convenient forms of construction in accordance with the invention are illustrated by way of example in the accompanying drawings and will now be described with reference to the drawings in which:

30 FIG. 1 is a general plan view of part of the knitting head of a single cylinder circular knitting machine equipped with latch needles and having six knitting stations spaced apart around the needle circle;

35 FIG. 2 is a plan view of the sinker cam and terry instrument cam assemblies which are superposed, with the cam tracks for the terry instruments shown in chain dotted lines lying underneath the sinker cams;

40 FIG. 3 is an enlarged detail cross-sectional view in elevation taken on the line III—III of FIG. 2 and shows a sinker cam slide and the assembled sinker and terry instrument as well as a cam plate adjusting means;

45 FIG. 4 is a similar enlarged detail cross-sectional elevation view taken on the line IV—IV of FIG. 2 and shows a terry instrument cam slide with the assembled sinker and terry instrument;

50 FIG. 5 is a diagrammatic elevation view on an enlarged scale of the ground yarn and terry yarn being fed to the needles as seen from within the needle circle in the direction of the arrow X in FIG. 1;

FIG. 6 is a plan view showing a segment of the cam ring assemblies in a modified form of construction, on a scale larger than that of FIG. 2;

55 FIG. 7 is a view in side elevation of parts shown in FIG. 6; and

FIG. 8 is a detail elevation view of certain parts in cross-section taken on the line VIII—VIII of FIG. 6.

In FIG. 1 only sufficient details have been shown to 60 illustrate the part of the machine with which the invention is concerned. The knitting stations are shown at 1,2,3,4,5 and 6. Some of the needles in the needle circle are indicated at 7 and a latchguard ring 8 is secured to the housing 9. Yarn trapping assemblies such as that shown at 10 are carried on a plate 11 which is maintained stationary within the needle circle on a supporting column 12 which is attached to the main housing 9 by means not shown. The latchguard ring and trapper

assembly can be raised clear of the needles by pivoting the housing about a shaft 13 which also carries feeder arms such as are shown at 14 and 15. The feeder arms are so arranged that their operating linkages 16 can collapse so that the assembly of feeders can be raised together with the latchring housing.

When the latchring housing 9 is raised it exposes a sinker cam plate 17 shown in FIG. 2. The sinker cam plate 17 (attached to the top of a housing 29, FIGS. 3 and 4) and a terry instrument cam plate 18 are contained in an assembly which is journaled on the upper end of the needle cylinder. The arrangement in this type of machine is that the needle cylinder revolves within the sinker cam assembly which is itself prevented from revolving. The sinker cam assembly may be allowed a limited amount of rotary movement known as shog, which is used for timing purposes when knitting is being performed by reciprocation.

In the machine illustrated the cam track 18a for actuating the terry instruments is constructed on the cam plate 18 which is attached to the underside of the sinker housing 29. The sinker cam track 17a shown in broken lines, is formed on the underside of the plate 17 for guiding the upstanding butts of the sinkers. The terry instrument cam track 18a shown in chain dotted lines is formed on the upper side of plate 18 for guiding the downwardly disposed butts of the terry instruments which are mounted side by side with the sinkers. Sectional side elevations of the arrangement are shown in FIGS. 3 and 4. The top of the cylinder 19 is provided with a flange or ring 24 having horizontal radial tricks each of which is situated between the vertical needle tricks as is normal in machines equipped with "outside" sinkers. A terry instrument 20 and a sinker 21 are provided in each of the horizontal tricks as shown in FIG. 3.

The plates 17 and 18 are attached to the housing 29 (with the sinkers and terry elements sandwiched between them) in such a manner that they can be displaced angularly with respect to one another and then locked together. This relative adjustment allows their respective cam tracks to be timed so that the terry instruments 20 may be advanced at the most appropriate time thus enabling the terry yarn to be drawn over the nibs 20a while the ground yarn passes under these nibs.

The relative positioning of the cam plates 17 and 18 is decided in the manner about to be described, it being assumed for simplicity that the machine is knitting yarns fed at a single feeding station, and both the ground yarn 22 and the terry yarn 23 (FIG. 5) are fed from separate feeding holes situated at appropriate levels on a single feeder arm. In this type of arrangement both yarns must be introduced to the needles at the same time and this is done by lowering the feeder arm so that the yarn extending from the feeders to the trapper cuts across the needle circle and is taken in the hooks of the needles. As the needles descend the stitch cam they draw loops of both yarns between the sinker draw edges and because at this stage the terry instruments are in their retracted position the needles draw double loops of the same size. When a few needles have taken the yarns the terry instruments are inserted (by operating a control in a manner which will be explained later) and FIG. 5 shows diagrammatically how the two yarns must be disposed to enable the nib 20a of the terry instruments to be inserted between them.

It can be readily appreciated that on machines in which a number of feeding stations are positioned closely to one another the lengths of yarn extending from the feeders to the needles have to be short and therefore the angle A (FIG. 5) is increased. This increased steepness of the angle of yarn feed makes the position at which the terry instruments are inserted more critical. If they are inserted too early they will pass under both the ground yarn and the terry yarn and if they are inserted too late they will pass over both yarns.

It can also be appreciated that the path of the yarns from feeder to needles will vary depending on the type of yarn being used. Some yarns will "balloon" while other of a less lively nature will travel in a fairly straight path. The construction illustrated in FIGS. 1 to 4 provides means for adjusting the terry instrument cam track 18a relatively to the sinker cam track on plates which are adjustable circumferentially with respect to one another and also relatively to the needle cams. The arrangement will now be described.

Referring to FIG 3 the needle cylinder 19 has the sinker ring 24 secured to it by segmental clamping plates 25 and screws 25a. Thus the sinker ring 24 revolves with the needle cylinder and carries the sinkers 21 and terry elements 20 with it in horizontally disposed tricks. The sinker cam plate is shown at 17 and the terry cam plate at 18. Their assembly is freely located on the sinker ring 24 and supported by the segmental plates 25. The assembly is prevented from revolving by an eccentric pin 26 which engages in a keyway 18b cut in the underside of plate 18. The pin 26 is screwed into a stationary part 27 and is rotatable by means of a hexagon flange 26a formed on the pin. When the pin is rotated, because it is eccentric of its threaded portion, it will move the cam plate assembly either clockwise or anticlockwise and then the pin can be locked by means of a nut 26b, thus maintaining the sinker and terry cam assemblies stationary after adjusting them correctly relatively to the needle cams.

The sinker cam plate 17 is clamped under the large heads of screws 28 (FIG. 2) to the sinker housing 29 (FIG. 3) which is itself located on the spigot 18c of the terry cam plate 18 and secured by screws 30 (FIG. 2). The holes 31 for these screws are slotted in the terry cam plate to allow the two cam plates to be adjusted circumferentially relatively to one another for the required relative timing adjustment.

It may be more convenient to provide an eccentric adjusting pin similar to the pin 26 in a convenient fixed part of the machine adjacent to the sinker housing and engaging in a slit in the housing. This would provide a facility whereby the sinker timing could be adjusted relatively to the needles and then, having obtained this initial setting, the adjusting pin could be locked. The timing of the terry instrument may then be obtained by using the first mentioned eccentric pin (26) to adjust circumferentially the terry cam track relatively to the sinker cam track and thereupon, by finally tightening the screws 30, the two cam plates are locked together.

As mentioned previously the terry instruments can be retained in their retracted position until both yarns have been taken by the needles and then the instruments are advanced to cause the terry yarn to be drawn into extended loops. The instruments are controlled in this manner by radially movable cams such as 32 (see

FIGS. 2 and 4). Each of these movable cams is attached to a slide such as 33 which is urged inwards by springs 34. A roller 35 attached to the slide is provided to co-operate with a cam 36a formed on a ring 36. Partial rotation of the ring causes the cam to act on the roller to retract the slide against the action of the springs. The cams 36a are formed on the ring in any desirable order according to the knitting requirements. It may, for instance, be desirable to insert only certain slides depending on the number of feeding stations which are active. Again, when knitting terry fabric in the heels or toes of articles it is only necessary to insert the slide associated with the main feeding station. The movement of the ring 36 is controlled through a link 37 from the main control drum (not shown) of the machine. A similar arrangement is provided for controlling cam slides such as 38 (FIG. 3) associated with the sinker cam track 17a, but as this is quite usual and has no real bearing on the present invention, it is not necessary to describe the arrangement in detail.

In the construction shown in FIGS. 1 to 4 relative adjustment of the terry instrument cams and the sinker cams about the cylinder axis to vary their relative timing is provided for without any provision for relative adjustment between the terry instrument cams at the several knitting stations. Whilst the construction so far described is adequate in many circumstances, it is advantageous to modify the construction in such manner as to permit also relative adjustment between the several terry instrument cams, for example to suit conditions when yarns having different characteristics are used at different feeding stations, and also to compensate for manufacturing discrepancies. Such relative adjustment between the terry instrument cams is provided for in the modifications to the cam assembly illustrated in FIGS. 6 to 8 now to be described. In the description which follows the reference numerals of corresponding parts appearing in FIGS. 1 to 4 are given also in brackets where applicable.

In the modified construction shown in FIGS. 6 to 8 the principal changes made are the substitution of differently formed and differently mounted terry instrument operating cams in place of the cams 32, and substituting a different means for withdrawing such cams, in place of the cam ring 36 and slides 33. In other respects the sinker and terry instrument cam assembly is the same or substantially the same as shown in FIGS. 1 to 4.

FIG. 6 shows a segment of the modified cam ring assembly seen in plan view corresponding to FIG. 2. A typical one of the terry instrument cams is indicated in FIG. 6 at 132(32) and is pivotally mounted on a fulcrum pin 101 which is fixed to a curved adjusting plate 102. There is a separate plate such as 102 for each terry instrument cam and the plates are all mounted in a circular channel 103 formed in the surface of the terry cam plate 118(18). The plate 102 is provided with a screwed post 104 in its underside which passes through a slot 118c in the base of the channel and permits the plate 102 to have individual adjusting movement along the channel. A lock nut 104a is used to secure the plate 102 in adjusted position. The sinker housing 129 (29) is cut away as shown at 129a FIGS. 6 and 7 to accommodate the cam 132.

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Mounted on a flange 118b of the cam plate is a post 105 for anchoring a tension spring 106 the other end of which is attached to a post 107 on the cam 132, see FIG. 6 and 7. The action of the spring 106 is to urge the cam in an anti-clockwise direction around the fulcrum pin 101 until the step 132a (FIG. 8) of the cam contacts the spigot rim 118d. Attached to the spring anchor post 107 in cam 132 is a cable 108 for pulling the cam in a clockwise direction to withdraw it to an inactive position. The cable 108 is carried in a cover 109 which is attached by an adjusting screw 110 to a post 111 fixed in the cam ring flange 118b. From the foregoing description it can be seen that each of the cams 132(32) for controlling the terry instruments is adjustable individually in a circumferential direction to the extent of the slot 118c(FIG. 6). This individual adjustment is additional to the collective adjustment afforded by moving the terry cam plate 18 relatively to the sinker cam plate 17 and allows the point of insertion of the terry instruments to be set differently at each yarn feeding position, appropriately for the knitting requirements.

In this arrangement just described each cam 132(32) is now controlled by an individual cable 108 from a suitable controlling means such as the main control drum of the machine.

What we claim is:

1. In a multifeed circular knitting machine including 30 latch needles in a needle cylinder, and a plurality of knitting stations spaced around the circumference of the needle cylinder; a sinker assembly comprising:
  - A. a sinker ring rotatable with the needle cylinder and having a plurality of tricks, a plurality of sinkers and a plurality of terry instruments mounted one of each side-by-side in said respective tricks of the sinker ring and having one set of operating butts on the sinkers projecting in a vertical direction and another set of operating butts on the terry instruments projecting in a vertical direction opposite to the direction of said sinker operating butts;
  - B. a circumferentially extending lower cam plate mounted outside said sinker ring, first cams slidably mounted in said lower cam plate at each of a plurality of said knitting stations for radial adjustment with respect to said lower cam plate and circumferential movement with said lower cam plate, said lower cam plate and cams serving to control one of said sets of operating butts for radial inward and outward movement, a circumferentially extending upper cam plate positioned above said sinker ring and mounted on said lower cam plate, second cams slidably mounted in said upper cam plate at each of a plurality of said knitting stations for radial adjustment with respect to said upper cam plate and circumferential movement with said upper cam plate, said upper cam plate and cams serving to control the other of said sets of operating butts for radial inward and outward movement; and
  - C. means for positioning and securing said lower cam plate in a range of circumferential positions relative to said knitting stations and means for positioning and securing said upper cam plate in a range of circumferential positions relative to the

lower cam plate, whereby the timing of the inward and outward movements of the sinkers and terry instruments can be varied relatively at all of said knitting stations simultaneously.

2. A circular knitting machine as set forth in claim 1, in which said machine includes stationary support means, and in which said means for positioning and securing said lower cam plate comprises an adjustable eccentric pin and means defining a slot for receiving said pin, wherein one of said pin and slot means is mounted on said stationary support means, and the other of said pin and slot means is mounted on said lower cam plate, whereby said eccentric pin is adjustable to vary an initial position of said lower cam plate.

3. A circular knitting machine as set forth in claim 1, 15

comprising operating means for said cams serving to control the set of operating butts for the terry instruments, said operating means comprising means for biasing said cams to operative positions and means for selectively moving said cams radially to inoperative positions.

4. A circular knitting machine as set forth in claim 1, comprising adjustable support means for mounting on the respective cam plate said cams serving to control the set of operating butts for the terry instruments, said support means comprising means for relative mutual circumferential adjustment of said cams and means for holding said support means in adjusted positions.

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