United States Patent

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[31] P 18 09 654.3

[54] **DEVICES FOR AUTOMATIC ADJUSTMENT OF DRAW TRAVEL OF SLUR COCKS IN STRAIGHT BAR KNITTING MACHINES**

6 Claims, 9 Drawing Figs.

[52] U.S. Cl. 66/89, 66/126
[51] Int. Cl. D04b 11/06
[50] Field of Search 66/82, 89, 126, 154

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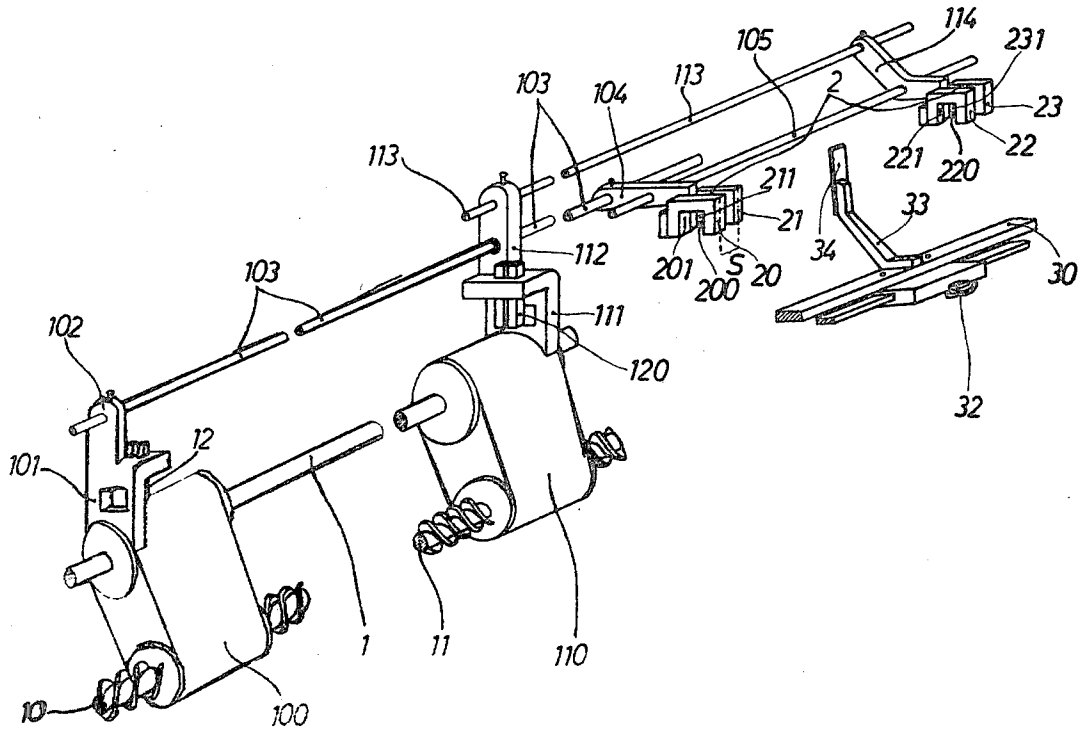
ABSTRACT: Sensing devices, such as photoelectric cells and lights for activating them, are mounted on rods for movement with adjustable yarn guides at opposite edges of a width of material being knit. Such yarn guides are adjustable by shifting nuts along lead screws. Movement of a light barrier relative to the sensing devices is coordinated with the slur cock reciprocation or yarn draw movement. Such barrier cooperates with a sensing device at the end of each slur cock stroke across the width of the material being knit so that, if the relationship between a sensing device and the light barrier at the end of one slur cock stroke changes, a signal will be generated by such sensing device for effecting adjustment of the slur cock travel to produce a new working margin of the material being knit corresponding to the differently adjusted position of the yarn guide and the sensing device connected to it. Drive mechanism for adjusting the length of slur cock stroke is actuated in response to the sensing device signal by a cam rotated in synchronism with the slur cock reciprocating mechanism.



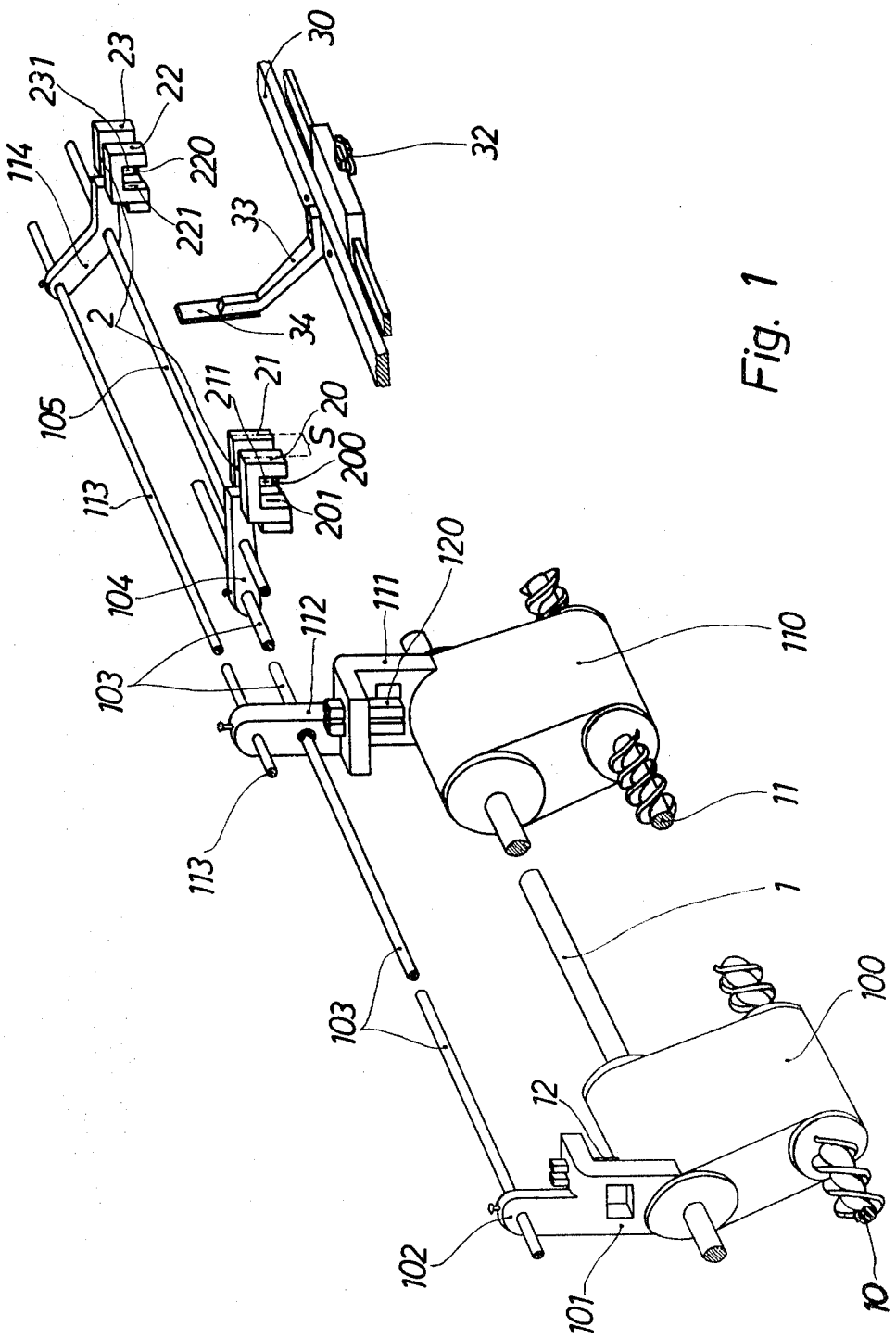


Fig. 1

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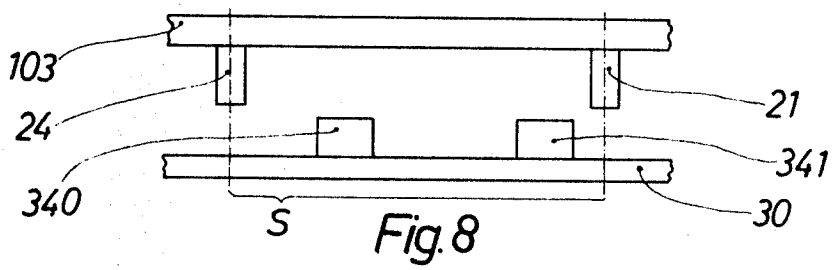

Fig. 8

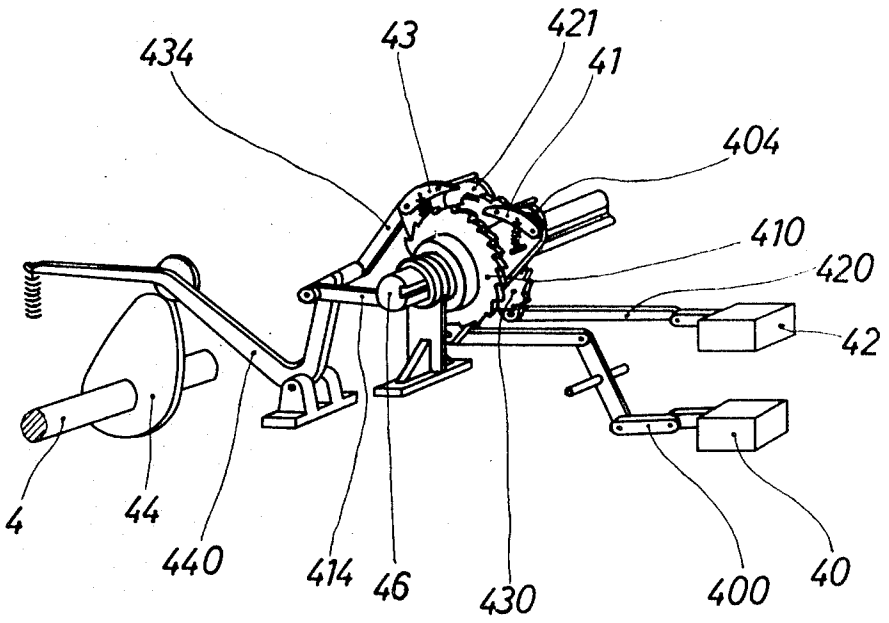

Fig. 2

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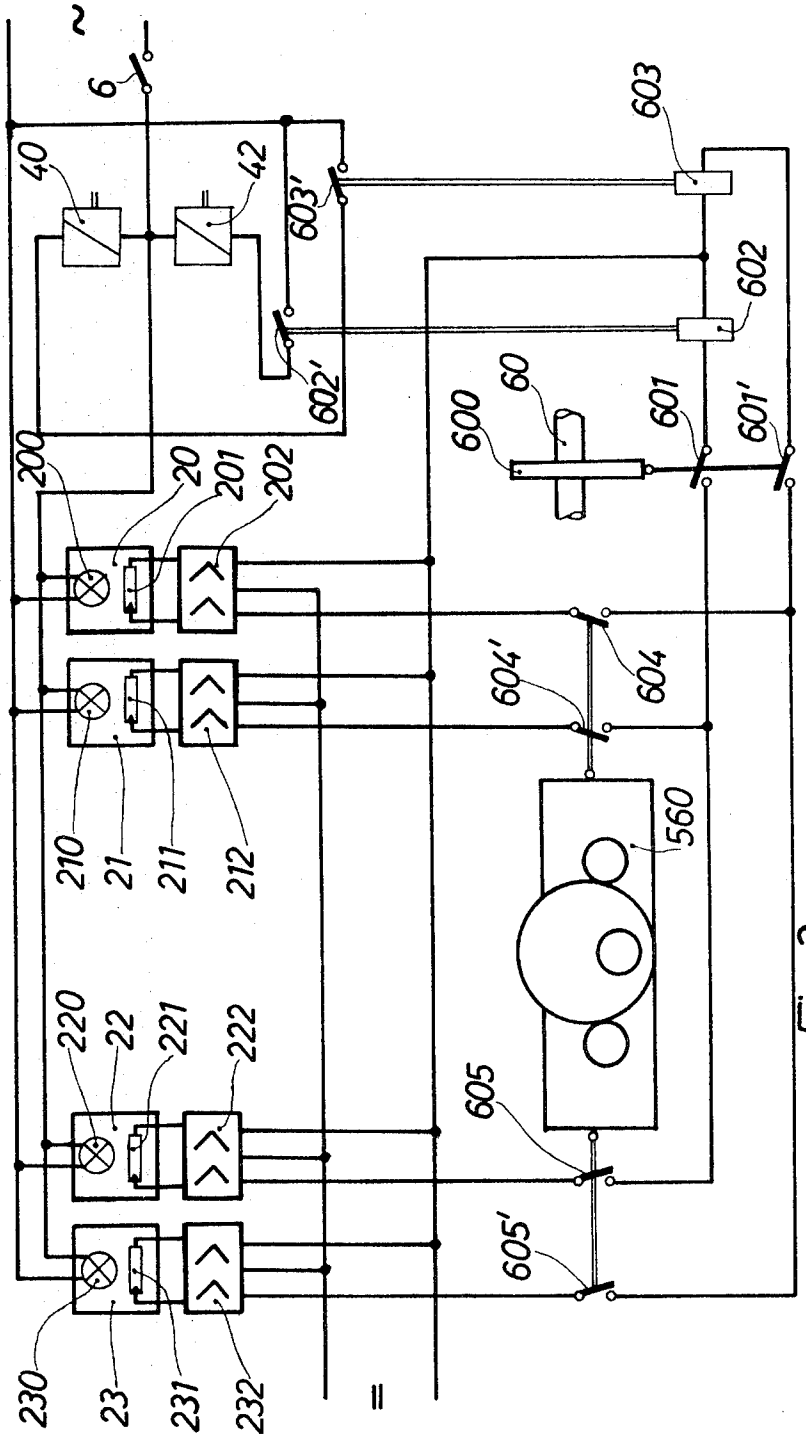

Fig. 3

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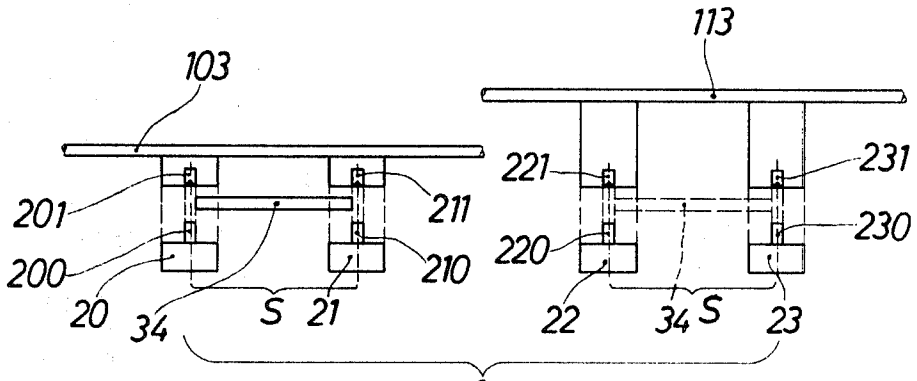

Fig. 4

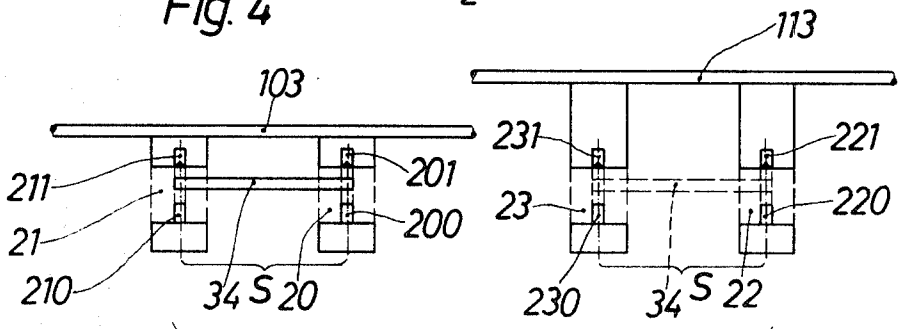

Fig. 5

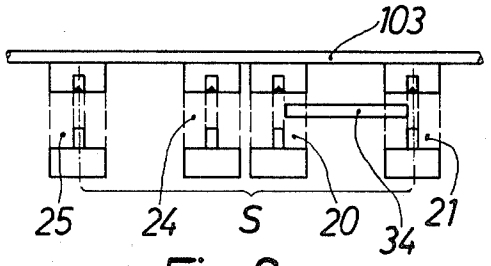

Fig. 6

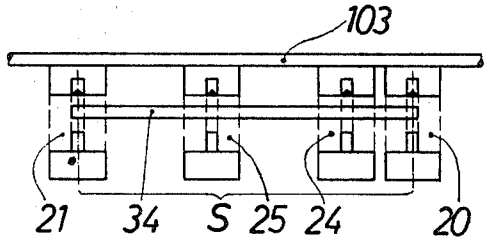

Fig. 7

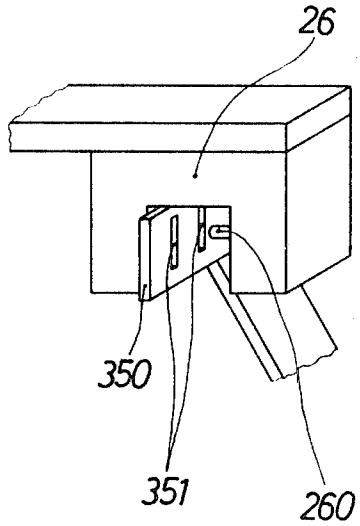

Fig. 9

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DEVICES FOR AUTOMATIC ADJUSTMENT OF DRAW TRAVEL OF SLUR COCKS IN STRAIGHT BAR KNITTING MACHINES

The present invention relates to devices for the automatic adaptation of the draw travel of the slur cocks in straight bar knitting machines so as to suit different working widths. More particularly the invention relates to a separately driven adjusting device for altering the slur cock draw travel and a control mechanism which is operated in accordance with the setting means for limiting the yarn guide travel.

For narrowing to take place on a straight bar knitting machine the efficiency of knitting time is decreased and thus there is a loss in production. Therefore extremely varied suggestions have been made in the past for the provision of means for adapting the slur cock travel for bringing about narrowings.

In accordance with one known device for a straight bar knitting machine for the production of ladies' stockings two abutments were to be provided on the slur cock rail which on reduction in the length of travel of the yarn guide, that is to say on narrowing, in their end position actuated a locking lever in order to release a roller lever of a pawl drive mechanism by means of bellcranks pivoted on yarn guide spindle nuts via a linkage connected with a control bar associated with the two bellcranks (see German Pat. No. 1,014,271). This device was to be provided on straight bar knitting machines for stocking production in which only narrowing was necessary and the device was therefore only suitable for reducing the travel of the slur cocks. If, however, the slur cock travel was to be increased, as for the production of outerwear, twice the number of abutments and linkages is necessary. Such a mechanical device would be comparatively complicated and bulky, so that in the case of knitting machines provided with patterning devices little space would be left. Furthermore such a device would be subject to wear since it operates with mechanical abutments which are unsuitable for rapidly operating machines.

One object of the present invention is therefore to provide a simple device for the automatic stepless adaptation of slur cock travel to different working widths both for narrowing and also for widening. The device should also operate securely and reliably even at high working speeds and large widths of material with the lowest possible power requirement.

The present invention consists in a device for the automatic adaptation of the draw travel of the slur cock in a straight bar knitting machine so as to suit different working widths, comprising a separately driven setting device for changing the draw travel, a control mechanism arranged to be operated in accordance with the setting means for limiting yarn guide travel, sensing means coupled with the setting means, for limiting the travel of the yarn guide, and at least one mark which is adapted to indicate the draw travel of the slur cock and which is arranged to be sensed by the sensing means at least at one end of its travel over an extent equal to the sum of the greatest widening step and the greatest narrowing step.

In accordance with a preferred embodiment of the invention the sensing means can have one sensing element for each size change in the yarn guide travel on increasing and decreasing respectively in order to allow for different changes in size of travel, for instance by one or by two needles. Alternatively, in accordance with a further embodiment of the invention the device comprises a sensing device with a single-sensing element, and such a mark whose length is equal to the extent which is to be sensed and which corresponds to the sum of the greatest increasing and the greatest narrowing step in the change in travel of the yarn guide, and furthermore has subdivisions corresponding to the step. Conveniently the mark is arranged to be sensed selectively at both ends or only at one end of its travel. This allows a substantial adaptation of the draw travel of the slur cock or cocks to the required working width, for example for the production of asymmetrical pieces of knitted fabric.

The use of such a sensing device offers the substantial advantage that the slur cock travel can automatically be changed for every widening as well as every narrowing of the working width. The device in accordance with the invention also requires little space and is reliable in the case of rapidly operating machines.

The invention is now described with reference to various embodiments as shown in the accompanying drawings.

FIG. 1 shows part of a straight bar knitting machine with a sensing device forming part of the invention, in perspective view.

FIG. 2 shows a setting device for setting the draw spindle, in perspective view.

FIG. 3 shows an electrical circuit diagram.

FIG. 4 to 9 show the cooperation of the mark with the sensing elements diagrammatically in the case of various different embodiments of the invention.

In accordance with the present invention the adaptation of the draw travel of the slur cocks **32** to suit the width of the article being knit is in accordance with the setting means for the limitation of the yarn guide travel, which, as shown in FIG. **1**, is set by means of the left-hand yarn guide lead screw or spindle **10** and its nut **100**, and by the right-hand yarn guide lead screw or spindle **11** and its nut **110**. Other means can be used for limiting the travel of the yarn guide so that instead of the abutments shown it is also possible to use sprocket chain wheels, adjustable ramps or the like. In the embodiment shown each of the two nuts, which are prevented from rotating by a common guide shaft **1**, comprises a lug **101**, **111** which serves for carrying one or more vertically sliding yarn guide abutments or stops **12** and **120**. The nuts **110** and **100** constitute yarn guide travel setting means.

The nut **100** is coupled with the sensing device **2** by means of a connecting rod **103** which is attached by means of a holding means **102** with the nut **100**. The nut **110** is coupled with the sensing device **2** via a connecting rod **113** which is connected with the nut **110** by means of an attachment means **112** which simultaneously serves for supporting the connecting rod **103** so as to allow longitudinal movement.

The sensing device **2** consists of two sensing elements **20** and **21** for the sensing of the left-hand end of the draw path of the slur cock **32**, and of the two sensing elements **22** and **23** for sensing the right-hand end of the draw travel or path of the slur cock **32**. The sensing elements **20** and **23** are for responding to or detecting a narrowing action while the sensing elements **21** and **22** respond to or detect an increase in the working width. The sensing elements **20** and **21** are carried by a holding means **104**, by means of which they are connected with the connecting rod **103** and thus with the nut **100**. The sensing elements **22** and **23** are in a similar manner connected with a holding means **114** and thus connected via the connecting rod **113** with the nut **110**. Both holding means **104** and **114** are mounted on a support rail **105** so as to be able to slide. The sensing elements can be in various forms, such as photoelectric detecting means with light beams, magnetic detecting means, pneumatic detecting means or as electrical sensing switches. The invention is described with reference to an embodiment using photoelectric sensing elements, each sensing element **20**, **21**, and **22**, **23** being provided with a light source **200**, **210**, and **220**, **230** and a photocell **201**, **211**, and **221**, **231**, as shown in FIGS. **1** and **3**.

With the help of the sensing device **2** a mark **34** in the form of a light barrier, is sensed at the end of its travel. The mark is attached to an arm **33** and is constructed for cooperation with the photoelectric sensing elements.

In order to indicate the slur cock travel, the mark **34** is connected with the slur cock connecting rail **30** or a similar part participating in the slur cock or draw movement. The movement of this part can be stepped up or stepped down in relation to the movement of the slur cock connecting rail **30** so that the mark **34** connected with this part performs, for instance, only a movement which is half that of the movement of the rail **30** connecting the slur cock. The same velocity ratio must also be provided for the drive of the sensing device **2**.

As shown in FIG. 2, the adaptation of the travel of the slur cock 32 to the working width set by means of the nuts 100 and 110 acting as setting means is carried out by means of a conventional ratchet drive whose pawls 41 and 43 are controlled by means of stops 404 and 421. The stop 404 is actuated by means of an electromagnet 40 (FIG. 2) via a linage 400 so that the pawl 41 engages one ratchet wheel 410. If an adjustment or setting in the opposite direction is to take place, an electromagnet 42 operates the stop 421 via a linkage 420 so that the pawl 43 can engage the ratchet wheel 430. The pawls 41 and 43 are driven via a linkage 414, 434 by a roller follower lever 440 which cooperates with a driving eccentric 44. The eccentric is fixed on the main eccentric shaft 4 and rotates with it. Since the actuating shaft 46, which is responsible for the setting of the draw lever drive ratio, takes part in the drawing movement, the shaft 46 has a longitudinal keyway and can be moved axially in relation to the ratchet drive.

The sensing of the draw travel can be carried out in two different manners by means of the sensing device 2 in accordance with whether the switching pulse for setting the draw travel is generated by interruption of the light beam of the photoelectric detecting means or by the light beam ceasing to be interrupted. In accordance with the mode of operation the arrangement of the sensing elements is set for narrowing or for widening with respect to the draw mark. It is firstly assumed that the setting magnitude is the same both from narrowing and also widening; for example a widening by one needle and a narrowing by one needle should take place.

Such a construction is shown in FIG. 4, the switching pulse being generated by interruption of the light beam between the light source 200 and 210 and the photocell 201 and 211. As is the case with FIG. 1, two sensing elements 22 and 23 are arranged for sensing the draw travel on the right-hand side so that the draw travel is sensed on both sides and can be immediately adjusted. If the draw travel agrees with the working width, the mark 34, for example in the left-hand end position, assumes a central position between the sensing element 20 and the sensing element 21. The two light beams are not interrupted and consequently no setting or adjusting pulse is generated. The same applies for the two sensing elements 22 and 23 on the right-hand side.

If the working width has been decreased by one needle on narrowing, the sensing elements 20 and 21 are moved to the right by the connecting rod 103 through this narrowing step. Consequently the mark 34 interrupts the light beam of the sensing element 20 in the lefthand end position. The pulse generated causes an adjustment or setting so that the draw travel is decreased by this narrowing step. If, on the other hand, the breadth of the material has been increased by one needle, the sensing elements 20 and 21 are moved to the left by the connecting rod 103 a distance equal to this widening step so that the mark 34 remains in its terminal position adjacent to the sensing element 21. The light beam is interrupted and thus the actuating pulse is generated for increasing the slur cock or draw travel.

The mark can thus be sensed over a distance of two needles, resulting from the sum of the narrowing step equal to one needle and the increasing or widening step equal to one needle. If the breadth of the mark is less than this distance of two needle pitches, the distance S between the sensing elements 20 and 21 amounts to two needle pitches; if the breadth of the mark is, on the other hand, greater, the path S must also be increased by the amount by which the mark breadth is greater than these two needle pitches. The manner of operation of the sensing elements 22 and 23 on the right-hand side is similar.

In the case of the embodiment in accordance with FIG. 5 the distance of the sensing elements 20 and 21 is so chosen that the mark 34 interrupts both light beams in the central position between the two sensing elements. If the working width is decreased, the sensing elements 20 and 21 are also displaced to the right through a distance equal to the size of the narrowing step. Since, however, the draw travel as indicated by mark 34 is greater, the right-hand sensing element is released so that a pulse is generated for decreasing the draw travel. This means that, unlike the arrangement in FIG. 4 the sensing element 20, is arranged for decreasing the draw path towards the middle of the bed, while the sensing element 21 is arranged for increasing the draw path towards the end of the bed. The same applies for the sensing elements 22 and 23 at the right-hand end of the draw path, which have positions opposite to those shown in FIG. 4.

On various occasions it may be necessary for the yarn guide travel to be adjusted at different sizes of adjustment steps. Thus, for example, widening may take place in a step equal to one needle while narrowing takes place in a step equal to one, two or four needles, If, for example, narrowing is to occur repeatedly in rapid succession with a step of two needles while the decrease in the draw path is only possible with a step of one needle, the adaptation of the draw path could not be carried out sufficiently quickly. Therefore, in accordance with the invention, the sensing device 2 can have one sensing element for each desired step size in the change of the path of the yarn guide both for narrowing and also for widening. Such a sensing device is shown in principle in FIGS. 6 and 7. In the case of the embodiment of FIG. 6 the switching pulse for the draw path adjustment is generated by interruption of the light beam, while in the case of the construction in accordance with FIG. 7 the switching pulse is produced by beam ceasing to be interrupted. In FIG. 6 the connecting rod 103 for the left-hand sensing elements 20, 21 24, and 25 for sensing the draw path is shown. The sensing element 21, arranged nearest the middle of the needle bed, generates the pulse for widening by one needle, the sensing element 20 the pulse for narrowing by one needle, the sensing element 24 the pulse for narrowing by two needles, and the sensing element 25 for narrowing by four needles. While the distance between the sensing elements 20 and 21 can be chosen as desired and only the breadth of the mark 34 need be adapted to suit this distance, the distance between the sensing elements 20 and 21 must amount to one needle pitch while the distance between the sensing elements 24 and 25 must amount to two needle pitches. If the mark 34 is not driven directly from the slur cock connecting rail 30 but is stepped up, the distances between the sensing elements 20 and 24 and 24 and 25 change in accordance with the velocity ratio.

In the arrangement in accordance with FIG. 6 the distance between the sensing elements 20 and 21 is so chosen that the mark does not cover both sensing elements in the central position. If a narrowing operation equal to two needles is to be carried out, the four sensing elements are moved to the right by the connecting rod by a distance corresponding to two needle pitches so that the mark 34 comes into its left-hand end position and is adjacent to the sensing element 24 and also the sensing element 20. The photoelectric sensing means are connected electrically with each other in such a manner that only the photoelectric sensing element 24 can be effective and the draw path is shortened by two needles. If the narrowing by four needles is to take place, the light beam of the sensing element 25 is interrupted and a draw path reduction takes place corresponding to four needles.

In FIG. 7 the arrangement of the same sensing elements is changed over in accordance with the other mode of operation, that is to say the sensing element 21 for increasing by one needle is arranged nearest the outer edge of the needle bed, while the sensing element 20 for decreasing by one needle is arranged nearest the middle of the bed. From inwards in an outward direction the sensing elements 24 and 25 follow. Otherwise this device operates in a manner similar to that shown in FIGS. 5 and 6.

In the embodiments or arrangements described up till now a mark consisting of a single switching lug was used for detecting the draw path. The length of this lug determines essentially what distance the sensing elements for generating the pulse for narrowing or for widening are to be arranged on one side of the draw path. In the arrangement in FIG. 8, however, the dispositions of the sensing elements 24 and 21 in relation to

each other can be as desired since each sensing element **24** and **21** has a switching lug **340** and **341** respectively associated with it. If, for example, a narrowing by two needles and an increase by one needle is to take place continuously in this arrangement, the manner of operation is as follows: Since the sensing element **21** detects the left-hand end of the draw path and reacts to an increase by one needle, when the draw path agrees with the working width the switching lug **341** stops in a position to the left of the light beam of the sensing element by a distance equal to one needle pitch. The switching lug **340** on the other hand is two needle pitches to the right of the sensing element **24**. If a widening by one needle is to be carried out, the sensing element **21** is displaced by one needle pitch to the left and the light beam is interrupted by the switching lug **341**, thus creating the generation of the switching pulse for the setting of the draw path. The distance of the switching lug **340** from the sensing element **24** has, however, been increased up to three needle pitches. On decreasing by two needles, however, the sensing element **24** is moved by two needle pitches to the right, so that the light beam is interrupted by the switching lug **340**. Thus, the distance of the switching lug **341** to the sensing element **21** is increased up to three needle pitches. In this position the switching pulse is generated for setting or adjusting the draw path.

With reference to the embodiment shown in FIGS. **4** to **8** it can be seen that the arrangement of the sensing elements can be varied in accordance with how the pulse for the setting or adjustment of the draw path is generated. The mark indicating the draw travel can be made of several switching lugs or switching cams so that for example a separate lug is used for the increasing sensing elements and decreasing sensing elements. This has the advantage that the arrangement of the sensing elements can be chosen so as to suit best the general construction of the knitting machine. FIGS. **4** to **8** only indicate principles given by way of example and can be exchanged one for the other.

The electrical arrangement of the devices described, for example in accordance with FIG. **5** is shown in FIG. **3**. For operating the electromagnets **40** and **42** controlling the stops **404** and **421** primary and secondary control circuits are provided. In the primary control circuit there are the four light sources **200**, **210**, **220** and **230** which are connected together in parallel and can be switched on and off by means of a suitable control device, for example, the main control device of the machine operating a switch **6** for switching on and off. Furthermore, the primary control circuit includes electromagnets **40** and **42** connected in parallel with the four light sources. In the secondary circuit, which is preferably fed with DC, photocells **201**, **211**, **221**, and **231** cooperating with the light sources **200**, **210**, **220**, and **230** are provided, each having an amplifier **202**, **212**, **222**, **232** each of the two outer photocells **201** and **231** and the two inner photocells **211** and **221** being connected together in parallel. By means of a switch with the contact **601**, **601'**, which is actuated by a cam disc **600** on the main eccentric shaft **60**, the photocells **211** and **221** are connected electrically with one relay **602** and the photocells **201** and **231** are connected with a relay **603**. The relay **602** has a contact **602'** in circuit with the magnet **42** and the relay **603** has contact **603'** in circuit with the electromagnet **40**.

By means of the switch **6** the light sources **200**, **210**, **220** and **230** are connected with the source of voltage, while the electromagnets **40** and **42** are disconnected from the source of voltage owing to the contacts **602'** and **603'** being opened. If, for example, the yarn guide path is diminished, one of the outer light beams, for example the light beam of the sensing element **23** is interrupted and a pulse is generated in the corresponding amplifier **232**.

In order to avoid such a pulse exciting the associated relay **602** or **603**, while the mark **34** is still moving, the switch contacts **601–601'** are only closed when the mark **34** has reached its terminal position. In this manner the relay **602**, for example, cannot be excited when the mark **34** interrupts the light beam of the sensing element **22** during its travel before reaching its final position. When the mark **34** has reached its end position, the switch contacts **601–601'** are closed by the cam disc **600** on the main eccentric shaft **60**. In the example given the relay **603** is thus excited and closes its contact **603'**. The electromagnet **40** is energized and thus releases the pawl **41** by operating the stop **404**.

The light beams of the other sensing elements **20**, **21**, and **22** are operated in a similar manner so that it is not necessary to described their manner of operation as well.

If a pulse is generated by a beam of light ceasing to be interrupted as in the above example, the draw path can only be sensed on one side. In order to be able to sense on both sides using the same principle, a periodically actuated circuit arrangement is provided by which the sensing device **2**, (or **26** which will be described below) is only operative at the end of the draw path of which the marks **34** (lugs **340**, **341**) and **350** (see below) are in the end position. Such a circuit arrangement can for example consist of switches **604–604'** and **605–605'** which are each closed in the end positions of the drawing beam **560**.

In the embodiment described up till now the adaptation of the draw path of the slur cock **32** in accordance with the working width is controlled according to the analog method. It is however, also possible to control its adaptation digitally by measuring the difference in travel in the form of pulses and comparing it with a preset travel, for example the set travel of the slur cock **32**.

An example of this manner of control is shown in FIG. **9**.

At one or both ends of the draw path of the slur cock **32** a single-sensing element **26** is provided with a light source **260** and with a photocell, not shown in the drawing. The photocell senses a mark **350** which has subdivisions **351** corresponding to the switching steps. The mark **350** has for this purpose a length which is at least equal to the path S to be sensed, which corresponds to the sum of the greatest increasing step and of the greatest decreasing step in the alteration of the yarn guide travel. Each subdivision which is brought passed the sensing element thus gives a pulse.

If, for example, the draw travel is to be increased, that is to say made broader, by one needle and narrowing is to be carried out by one, two or four needles, the greatest increase step is equal to one needle and the greatest narrowing step is four needles. The minimum length of the mark **350** must therefore amount to five needle pitches, which contain six subdivisions **351**. If, for example, widening is carried out equal to one needle, only one subdivision **351** is driven passed, so that only one pulse is generated. By one pulse the draw path is increased by one needle. With two pulses the working width is not modified so that the draw path is also not changed. Similarly the draw path is decreased by four needles in the case of six pulses.

It is naturally also possible to omit subdivisions for step sizes which are not provided for. Thus, if there is no provision in the machine or a reduction of the yarn guide travel by three needles, the corresponding subdivision **351** can be omitted while maintaining the distance between the subdivision for a reduction in the travel of the slur cock by four needles and the subdivision for a reduction by two needles. As a result five pulses lead to a reduction in the draw path by four needles.

Besides sensing elements operating with light beams it is also possible to operate pneumatically and magnetically operating sensing means and also sensing means operating with oscillating circuits. In this case the components necessary for leading to a response so as to produce the action of a sensing device can be present partly on the sensing element and partly on the mark. For example as a mark it is possible to make use of a source of light while the sensing element is a photocell, and vice versa. Furthermore, the pulses necessary for control can be derived from the cooperation of sensing switches and ramps.

Thus, it is for example possible to provide photocells as the subdivisions **351** in FIG. **9**, the photocells generating pulses in accordance with whether the working width is to be changed

or not changed by cooperation with the light source **260**. On the other hand, it is possible to provide instead of the light source **260** a single photocell while several light sources are provided as subdivisions.

The pulses sensed by a sensing element can also be transmitted nonelectrically, for example pneumatically or hydraulically so that instead of the electromagnets hydraulic or pneumatic plungers or pistons are used for controlling the stops **404** and **421**.

In order to make possible a substantial adaptation of the draw travel of the yarn guide path in the case of asymmetrical pieces of knitted material it is advantageous if during the production of symmetrical pieces of knitted material the mark is sensed at both ends of its travel and during the production of asymmetrical pieces of knitted material the mark is sensed at the end of its path furthest removed from the middle of the bed. For this purpose the sensing elements associated with the other end are preferably arranged so that they can be switched off and cease to function.

When the draw path has been reduced to a certain minimum size, the whole sensing device can be switched off by actuating the switch **6**.

We claim:

1. A device for the automatic adaptation of the draw travel of slur cocks in a straight bar knitting machine to suit different working widths of material being knit in accordance with the limits of travel of a yarn guide, including setting means for limiting the travel of such yarn guide, the improvement comprising sensing means coupled with the yarn guide travel limit setting means, slur cock draw travel responsive means moved in coordination with the travel of a slur cock and cooperating with said sensing means, and control means operated by the coaction of said slur cock draw travel responsive means and said sensing means, at least at one end of the travel of said slur cock draw travel responsive means, to effect adjustment of said slur cock draw travel responsive means automatically in response to adjustment of the yarn guide travel limit setting means.

2. The device defined in claim **1**, in which the control means is capable of effecting adjustment of the slur cock draw travel responsive means at an end of its travel through a range equal to the sum of the greatest widening step and the greatest narrowing step at such end of the travel of the slur cock draw travel responsive means.

3. The device defined in claim **1**, in which the sensing means includes one sensing element for each size of change in setting of the yarn guide limits of travel corresponding to an increase in width and to a decrease in width, respectively, of the material being knit.

4. The device defined in claim **1**, in which the sensing means includes a sensing element and a cooperating element having a length capable of overlapping the sensing element to a degree corresponding to the sum of the greatest widening step and the greatest narrowing step of the setting means, and in addition has subdivisions within such range.

5. The device defined in claim **1**, in which the slur clock draw travel responsive means is arranged to cooperate with the sensing means at both ends of the travel of the slur cock draw travel responsive means.

6. The device defined in claim **1**, in which the control means includes a periodically actuated switch device operable at an end of the travel of the slur cock draw travel responsive means to effect adjustment of the slur cock draw travel responsive means in accordance with the interaction of the sensing means and the slur cock draw travel responsive means.