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(54) A straight bar knitting machine.

(57) A straight bar knitting machine including a slurbar reciprocally mounted in a frame of the machine and carrying a slurcock for each knitting section, an electronically controllable drive motor mounted on the frame, the drive motor being drivingly connected to the slurbar to cause reciprocal motion thereof, and control means operable on said motor for controlling the speed, direction and stroke displacement of the slurbar for each knitting cycle of the machine.

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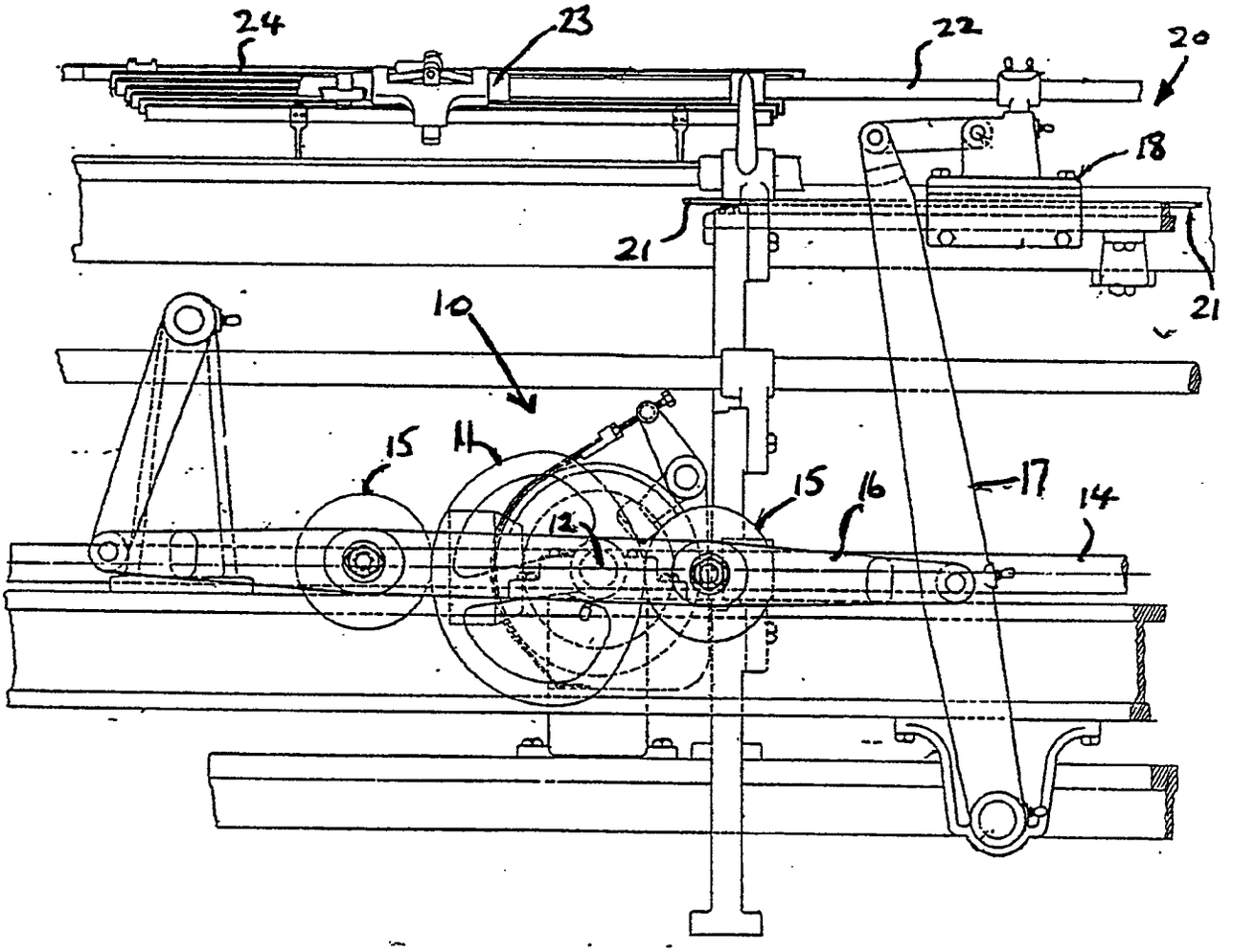


FIG 1

This invention relates to straight bar knitting machines.

A typical example of a straight bar knitting machine is produced by Bentley-Cotton Ltd and commonly referred to as a "Cottons Patented" machine. Straight bar knitting machines are provided with a plurality of carrier rods and a slurbar; each carrier rod carrying a yarn guide and the slurbar carrying a slurcock for each knitting section.

Conventionally, the slurbar is reciprocated by a draw mechanism which includes a large draw cam and co-operating levers which is driven by the main camshaft of the knitting machine. The Slurbar in turn reciprocally drives the carrier rods in synchronism via a friction box mounted on the slurbar.

For each knitting cycle, the slurbar and carrier rods undergo one stroke of reciprocal motion and the displacement of the slurbar is greater than that of the carrier rods so that for each knitting section the slurcock trails behind a yarn guide. The differential in stroke of the slurbar and carrier rods is accommodated by the friction box.

Adjustment of the stroke of the slurbar for narrowing and widening purposes is achieved by mechanically adjusting the operating levers driven by the draw cam so as to vary their effective displacement.

It is a general aim of the present invention to replace the draw mechanism for driving the slurbar by an electronically controllable drive means. This has the advantage of dispensing with a relatively large draw mechanism which is prone to wear and requires continual maintenance. In addition it enables the stroke of the slurbar to be easily changed.

It is also a further object of the present invention to independently drive the carrier rods by electronically controllable drive motors so as to dispense with the drive linkage between the slurbar and the carrier rods.

According to the present invention there is provided a straight bar knitting machine including a slurbar reciprocally mounted in a frame of the machine and carrying a slurcock for each knitting section, an electronically controllable drive motor mounted on the frame, the drive motor being drivingly connected to the slurbar to cause reciprocal motion thereof, and control means operable on said motor for controlling the speed, direction and stroke displacement of the slurbar for each knitting cycle of the machine.

Preferably the drive motor comprises an electric motor which may be a 5.5 kw, 3 phase 415 volts AC motor with an inverter drive, or similar DC stepper motor.

In one embodiment of the invention the knitting machine includes a plurality of carrier rods and a drive motor is provided to drive directly the, or each, carrier rod and to drive the slurbar so that each rod and slurbar are independently driven.

The or each drive motor preferably drives its respective rod or slurbar via a rack and pinion arrangement. The rack may be provided on the respective rod or slurbar and the pinion may be driven by the respective drive motor. This is a particular advantage since it allows existing straight bar knitting machines to be converted.

The control means may comprise a computer, and may also comprise first position sensing means to sense the position of the or each rod and the slurbar whereby signals are transmitted from the first position sensing means to the computer such that the speed of the or each drive motor can be controlled. The control means may also comprise second position sensing means to sense the angular position of the camshaft of the knitting machine thereby to determine the stage in the knitting cycle of the knitting machine; whereby at selected positions in the knitting cycle the control means may activate a selected one or more of the, or each, drive motor thereby to drive a selected one or more of the, or each, rod and the slurbar.

The number of rods may be varied as desired. In one embodiment, the knitting machine comprises a plurality of rods, preferably four, and a corresponding number of drive motors are provided for the rods and the slurbar.

The provision of four independently driven rods is particularly useful when it is desired to create an intarsia pattern.

In another embodiment, the machine comprises a plurality of rods, preferably four, and one drive motor to drive the slurbar, the rods being selectively driven by friction means which connects the slurbar to a selected one of the rods.

It is a particular advantage of this invention that it achieves greater production by means of increased speed.

Various aspects of the present invention are hereinafter described with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of the draw mechanism of a conventional straight bar knitting machine;

Figure 2 is a schematic diagrammatic view of a first embodiment according to the present invention;

Figure 3 is a diagrammatic view showing a second embodiment of the present invention;

Figure 4 is a schematic diagram of a control system for controlling the drive motors shown in Figure 1.

Referring initially to Figure 1, there is shown a typical draw mechanism 10 for a straight bar knitting machine.

The draw mechanism 10 includes a draw cam 11 which is mounted on a shaft 12 driven from the main camshaft 14 at half the speed of the main camshaft 14. Cam followers 15 mounted on a horizontal link 16 cause a lever 17 to be reciprocated.

The lever 17 is connected to a slide 18 which is fixedly secured to a slurbar assembly 20 including a slurbar 21 on which slurcocks (not shown in Figure 1) are mounted and carrier drive bar 22 on which a friction box 23 is mounted. The friction box 23 is selectively connectable with selected carrier rods 24. Accordingly reciprocation of the lever 17 causes reciprocal synchronised movement of the slurbar 21 and carrier rods 24.

In some straight bar knitting machines the drive linkage between the draw cam 11 and slurbar 21 differs from that shown although the principle of operation is basically the same. In addition, in some machines the friction box 23 is directly mounted on the slurbar 21. The present invention is intended to embrace these differing arrangements.

In accordance with the present invention, the conventional draw mechanism 10 is dispensed with and replaced by an electronically controlled drive motor 30 which directly drives the slurbar assembly 20 for causing reciprocation of the slurbar assembly and the carrier rods 24. Thus in the machine illustrated in Figure 1, cam 11 and mechanical linkages to the slide 18 are removed.

This arrangement according to the present invention is shown schematically in Figure 2.

In Figure 2 the slurbar 22 is shown having the friction box 23 mounted thereon. Reciprocation of the slurbar 22 is achieved by motor 30 driving a rack and pinion arrangement 31, the pinion 32 being driven by the motor 30 and the rack 33 being secured to the slurbar 22.

Preferably the motor 30 drives the pinion 32 via a gearbox having no backlash. This enables the motor 30 to accelerate, decelerate and stop the slurbar in a positive manner with minimum play. The motor 30 is preferably an A/C motor which is driven via an invertor drive capable of delivering a relatively large amount if power at acceleration and deceleration. Typically the arrangement is such that the slurbar is moved along a single stroke in about 0.2 seconds and that acceleration to a constant speed and deceleration is achieved in milliseconds. This means that for the majority of the stroke of the slurbar, the slurbar is displaced at a constant speed. A typical arrangement would be a 5.5K watt motor driven by a 11K watt A/C invertor.

By disconnecting the conventional draw mechanism 20, synchronism of the slurbar and carrier rod motion with the remaining operating motions of the knitting machine are no longer provided. Accordingly an electronic control system is provided which operates the motor 30 to determine the direction, speed and distance travelled by the slurbar arrangement in order to synchronise the motion of the slurbar and carrier rods with the remaining components of the machine. In order to determine the status of the machine in a knitting cycle, main drive sensing means 58 are provided which indicate the rotational position of the main drive shaft.

This may be achieved by an encoder (not shown) driven directly by the main cam shaft or by a proximity sensor 45 which senses the rotational position of the sensing disc 46 driven by the half speed shaft 12. The disc 46 preferably has two protrusions 47 which are sensed by the proximity sensor 45; each protrusion 47 being located to indicate the position of the main camshaft 14 at the start of a knitting cycle.

In the embodiment illustrated in Figure 2, a pair of stops 50,51 are provided for engaging the friction box 23 to thereby arrest its motion on reciprocation of the slurbar 21 and thus define the limits of reciprocation of the carrier rods 24 driven thereby.

In order to arrest the motion of the slurbar 21, a pair of sensors 60,61 are preferably provided on each stop 50,51 respectively. A first sensor 60 is provided to sense the presence of the friction box 23 as it approaches the associated stop 50,51 and produces a first signal which is sent to the control system. The control system responds to the first signal by initiating a deceleration of the motor 30. This has the effect of slowing the friction box 23 before impact with the stop and so reduces inertia forces on impact. The slurbar 21 continues its motion and the second sensor 61 senses the position of the slurbar after having travelled a predetermined distance beyond the stop position of the friction box. The second sensor 61 produces a second signal which is sent to the control system and is used thereby to stop the motor 30 and thus arrest the slurbar. The slurcocks are now in a trailing position behind the yarn feeders in readiness for the next knitting cycle. The overtravel of the slurbar beyond the limit of travel of the friction box 23 is not critical and typically is about 2.5 inches (62.5mm).

The sensors 60,61 associated with each respective stop also indicate to the control system which limit of reciprocation the slurbar 21 has reached. This information is used to reverse the direction of the motor 30 for the next cycle. In addition this information is used to return the slurbar to the correct side of the knitting section in readiness for the commencement of a fresh knitting sequence.

The sensors 60,61 are preferably proximity sensors and the slurbar 21 is provided with projection 66 at predetermined locations for co-operation with the proximity sensors 61.

It will be appreciated that on some straight bar knitting machines, the adjustable stops 50,51 are provided for engagement with the carrier rods for defining their limits of reciprocal motion. For such machines the sensors 60,61 would be mounted on these stops with sensor 60 being arranged to determine the presence of a carrier rod as it approaches the associated stop and thereby produce the first signal. The second sensor 61 would still sense the position of the slurbar as before.

An advantage of mounting the sensors 60,61 on the adjustable stops is that the arresting position of the slurbar is automatically adjusted when the stops are moved. Movement of the stops 50,51 is achieved in a conventional manner.

It will be appreciated that this invention is particularly suitable as an adaptation of a conventional straight bar knitting machine, such as the knitting machines produced by Bentley Cotton Limited. An example of such a knitting machine is described in Knitting Technology - Second Edition by David J Spencer, publishes by Pergamon Press.

In Figure 3 an alternative embodiment is illustrated showing a straight bar knitting machine having 4 carrier rods 24. The rods 24 carry yarn guides (not shown) to deliver yarn to the needles (not shown) of the knitting machine. Each rod 24 is driven with reciprocating motion as indicated by the arrow A by individual drive motors 12. Each drive motor 112 is connected to a pinion 112a of a rack and pinion arrangement, the pinion 112a being in meshing arrangement with a rack 112b provided on each rod 24.

Also shown in Figure 1 is a slurbar 14 which carries a slurcock 16 for moving sinkers (not shown) from a retracted position to a yarn engaging position.

In the embodiment of Figure 3, the slurbar 21 is also driven by the drive motor 30 in the manner described in the embodiment of Figure 2. The drive motors 30,112 can be, for example, an electric motor such as a 5.5 kw, 3 phase 415 volts AC motor with an inverter drive, or similar DC stepper motor.

The motor should such that it is possible to control it accurately so that the yarn is delivered each time across the correct needles and so that the slurbar moves the slurcock accurately to the desired positions.

The drive motors 30,112 are electronically controlled by a computer. The computer will determine when the drive motors 112 are switched on and off to drive or stop, as the case may be, the respective rods 2 or slurbar 14.

Figure 4 shows a schematic diagram of a control system which can be used to control the drive motors 30,112. The control system comprises a pattern preparation system, an extended CRP 1.5 controller, position sensing means in the form of encoders and drive motors for the rods 24 and the slurbar 21. When the knitting machine is to be used to create an intarsia pattern, then all four rods 24 can be used. However, for ordinary striping knitting operations, only one of the rods 24 need be used per course.

The control means comprises first position sensing means to sense the position of the rods 24 and the slurbar 21. The position sensors may be in the form of an encoder driven by the motor for each rod 24 or slurbar 21 and transmit to the computer the positions of its respective rod 24 or slurbar 21. Thus, the computer can determine accurately the position of each rod 24 and the slurbar 21 whereby their motion during he knitting cycle can be accurately controlled.

The computer can be programmed so that it activates a selected one of the drive motors 30,112 at first selected angular positions of the main camshaft. When the selected drive motor 30,112 is activated, the rod 24 or slurbar 21 moves in reciprocating motion a desired number of cycles as monitored by the first position sensing means. The speed, acceleration and deceleration of the rod 24 or slurbar 21 can be monitored and adjusted to reduce stress on the yarn. When the rod 24 or slurbar 21 reaches a first desired position eg at a selected needle position for a carrier rod, the computer reverses the drive motor 112 to return the rod 24 or slurbar 12 to its original position.

Thus by appropriately programming the computer it is possible to activate and deactivate individually each of the drive motors 30,112 at any selected angular position of the main camshaft.

The invention has the advantage that the monitoring of the positions of the rod 24 and the slurbar 21 enables a check to be made to ensure that the rod 24 or slurbar 21 has completed a whole number of cycles and has returned to its original position at the same time as the computer deactivates the respective drive motor 112.

Claims

1. A straight bar knitting machine including a slurbar reciprocally mounted in a frame of the machine and carrying a slurcock for each knitting section, an electronically controllable drive motor mounted on the frame, the drive motor being drivingly connected to the slurbar to cause reciprocal motion thereof, and control means operable on said motor for controlling the speed, direction and stroke displacement of the slurbar for each knitting cycle of the machine.

2. A straight bar knitting machine according to claim 1, including a main drive sensor for producing signals indicative of the status of the knitting cycle of the machine.

3. A straight bar knitting machine according to claim 2, wherein the drive sensor comprises an encoder driven by the main camshaft of the knitting machine.

4. A straight bar knitting machine according to claim 3, wherein the drive sensor includes a proximity sensor co-operable with a rotating member driven at a reduced speed by the main camshaft.

5. A straight bar knitting machine according to any

of claims 1 to 4, including a first sensing means for determining the position of the slurbar when travelling in one direction of its reciprocal movement and a second sensing means for determining the position of the slurbar when travelling in the opposite direction of its reciprocal movement, the first and second sensing means providing signals to the control means to arrest motion of the motor and thereby define the limit positions of the slurbar.

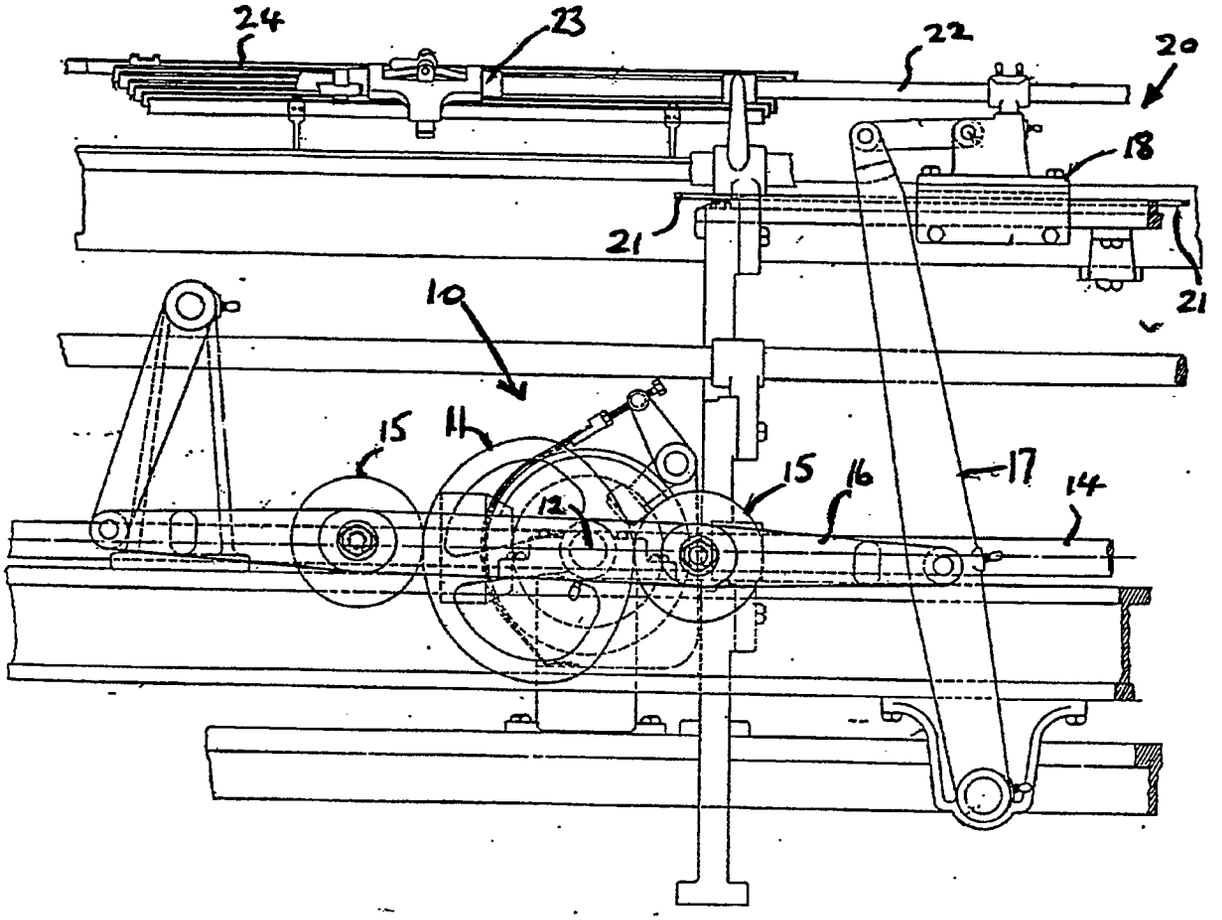
6. A straight bar knitting machine according to claim 5, including at least one yarn carrier bar reciprocally mounted in the frame, the slurbar having a friction box mounted thereon which is selectively engageable with a selected yarn carrier bar to cause movement thereof in unison with the friction box, and first and second adjustable selvedge stops movably mounted on the frame for co-operation with the friction box so as to define limits for the reciprocal motion of the friction box, the first sensing means being mounted on said first stop and the second sensing means being mounted on said second stop.

7. A straight bar knitting machine according to claim 6, wherein the first and second stops are engageable with the friction box to arrest its motion, the first and second sensing means each comprising a first sensor arranged to produce first signal indicative of the presence of the friction box as it approaches the associated stop and a second sensor arranged to produce a second signal indicative of a predetermined position of the slurbar beyond the limit position of the friction box, the control means being operative to decelerate the motor in response to said first signal and to stop the motor response to the second signal.

8. A straight bar knitting machine according to claim 6, wherein the first and second stops are engageable with a carrier rod to arrest its motion, the first and second sensor means each comprising a first sensor arranged to produce a first signal indicative of the presence of the carrier rod as it approaches the associated stop and a second sensor arranged to produce a second signal indicative of a predetermined position of the slurbar beyond the limit position of the carrier rod, the control means being operative to decelerate the motor in response to said first signal and to stop the motor in response to the second signal.

9. A straight bar knitting machine according to claim 7 or 8, wherein both of said first and second sensors comprise proximity sensors.

10. A straight bar knitting machine according to any of claims 1 to 4, including at least one yarn carrier bar reciprocally mounted in the frame, the or each yarn carrier bar being provided with a respective electronically controllable drive motor which is operatively controlled by said control means such that the slurbar and each carrier rod is independently driven.


24
23
22
20
18
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21
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11
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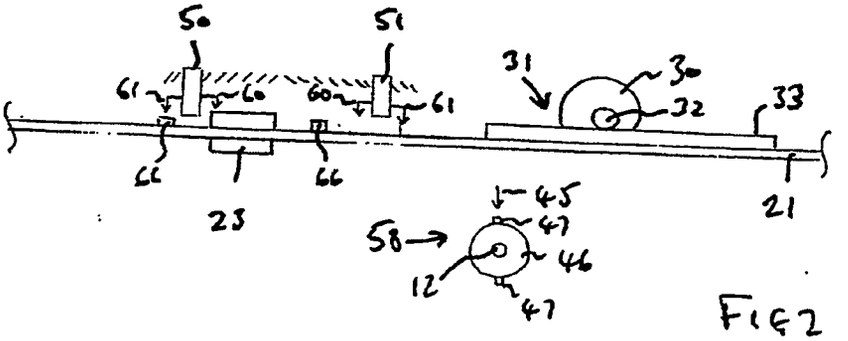
17
14
12

FIG 1


50
51
61
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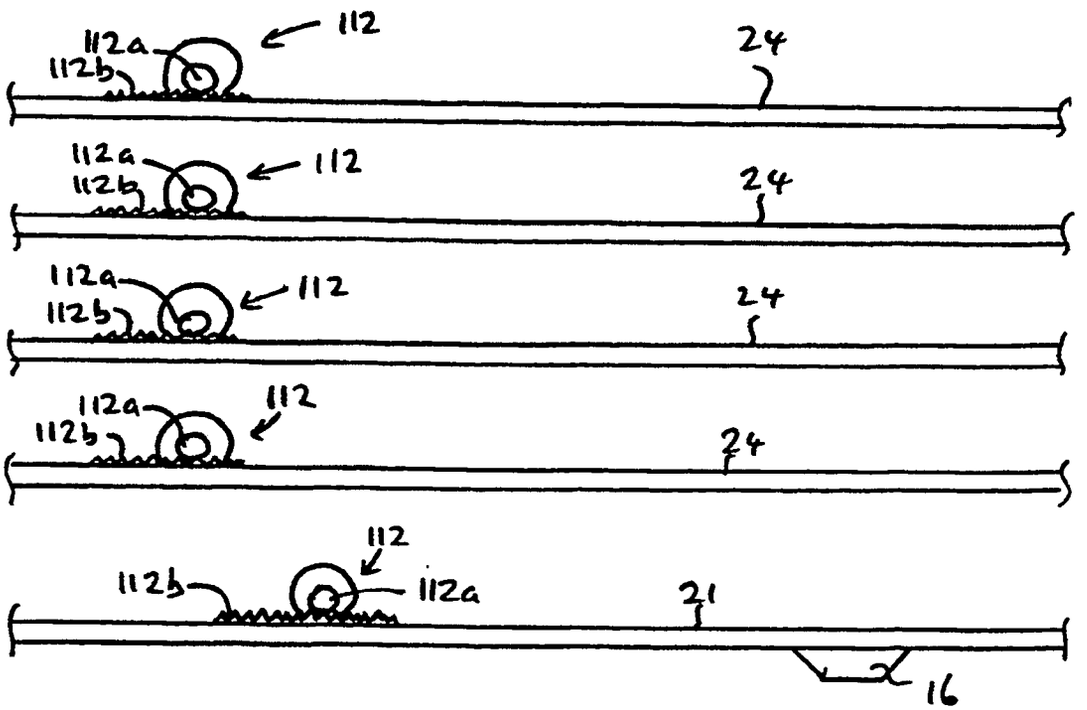
47
58
46
12
47

FIG 2


112a
112b
112
24
112a
112b
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24
112a
112b
112
24
112
112b
112a
21
16

FIG 3

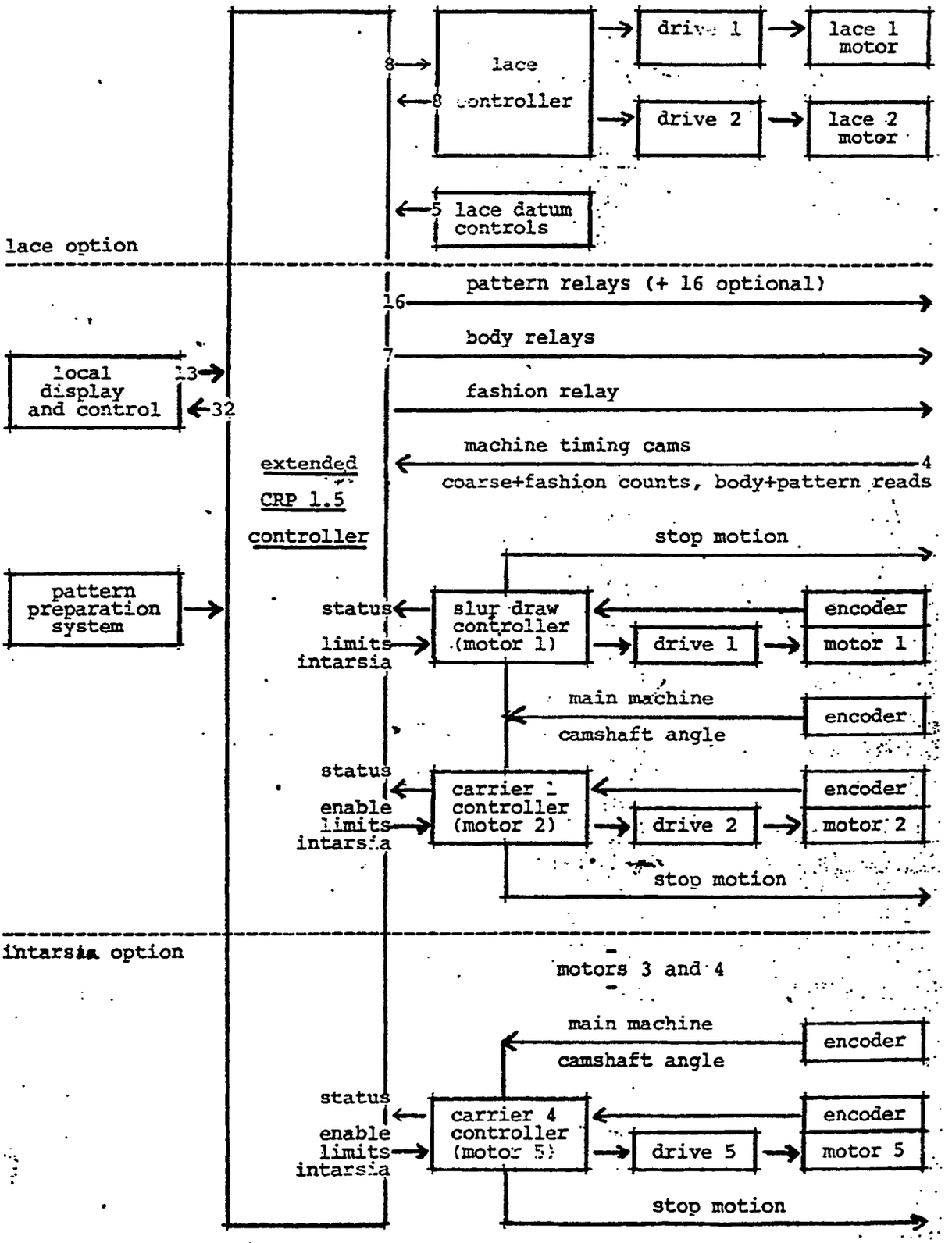
lace option
8
lace controller
8
drive 1
lace 1 motor
drive 2
lace 2 motor
5 lace datum controls
pattern relays (+ 16 optional)
16
body relays
7
fashion relay
machine timing cams
4
coarse+fashion counts, body+pattern reads
stop motion
local display and control
13
32
extended CRP 1.5 controller
pattern preparation system
status
limits intarsia
slur draw controller (motor 1)
encoder
drive 1
motor 1
main machine camshaft angle
encoder
status
enable limits intarsia
carrier 2 controller (motor 2)
encoder
drive 2
motor 2
stop motion
intarsia option
motors 3 and 4
main machine camshaft angle
encoder
status
enable limits intarsia
carrier 4 controller (motor 5)
encoder
drive 5
motor 5
stop motion

FIG 4