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Hadam et al.

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[54] **METHOD AND ARRANGEMENT FOR TRANSMITTING CONTROL SIGNALS TO THE CARRIAGE OF A FLAT KNITTING MACHINE**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **66/154 A**

[51] **Int. Cl.** **D04b 15/66**

[58] **Field of Search** ..... 66/75, 154 A

[56] **References Cited**

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Attorney—Robert B. Larson et al.

[57] **ABSTRACT**

Control signals for controlling the movement and setting of the carriage of a flat knitting machine are transmitted from a stationary program carrier to the carriage at predetermined intervals only by means of signal transmission arrangements which are operable only at predetermined intervals, the signals being transmitted preferably through a plurality of channels, and the program carrier preferably being centrally located so as to control a plurality of machines. The signals may be transmitted from stationary signal emitters in the form of contact bars disposed in the direction of travel of the carriage to contact brushes or pins which are carried by the carriage to slide over the stationary contact bars. Alternatively, signal transmission may be transmitted optically from stationary light strips to photo-electric converters carried by the carriage, or by stationary magnetic field inductors and reed contacts provided on the carriage. The emitters are so arranged that signal transmission occurs over only a relatively short length of the total carriage stroke, and where the transmission occurs between the ends of the strokes the signals can be stored on the carriage until the end of the stroke. A coordinating arrangement can limit the signal transmission period to less than the total period of confrontation between the emitters and receivers during the carriage stroke, so as to initiate transmission after confrontation and terminate transmission during confrontation.

6 Claims, 9 Drawing Figures

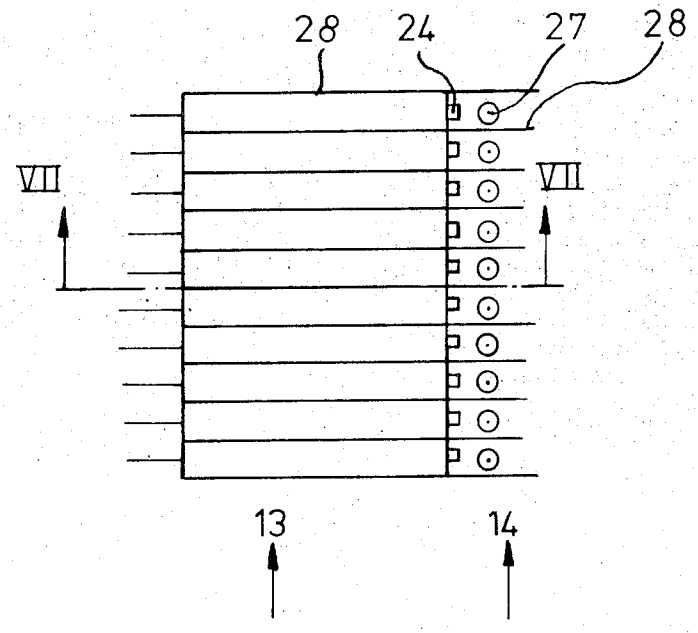


Fig. 1

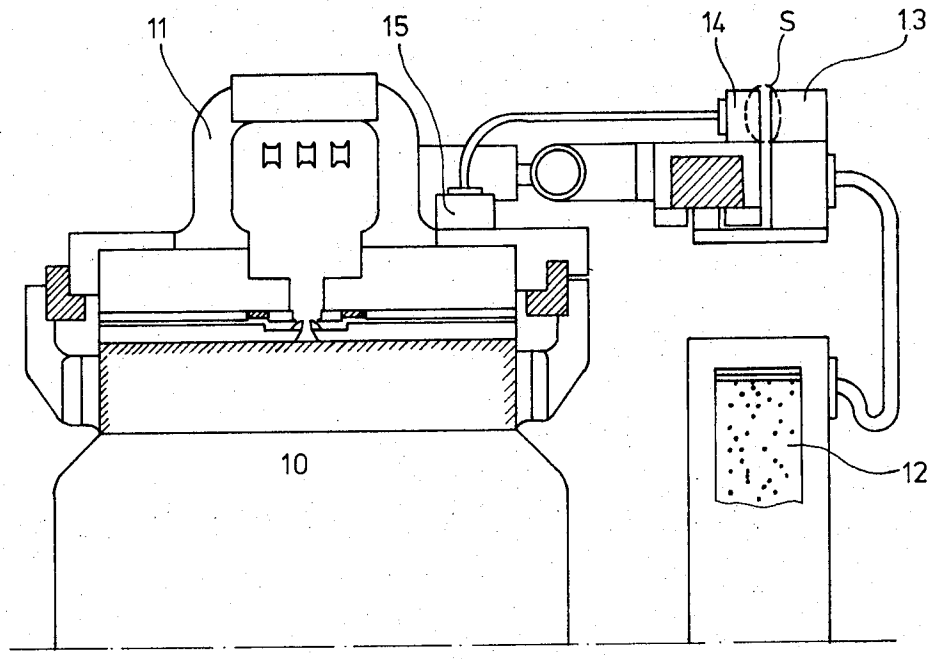


Fig 2

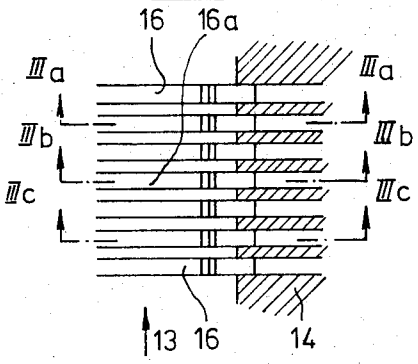
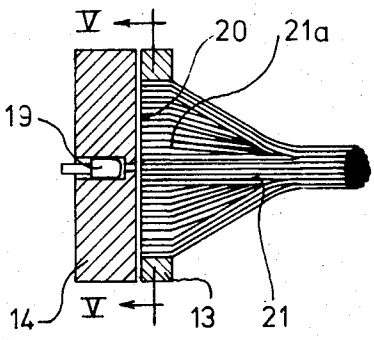


Fig 4



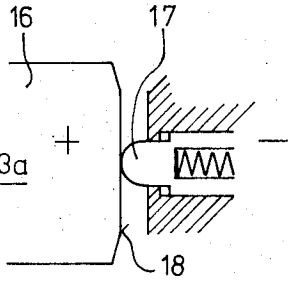


Fig 3a

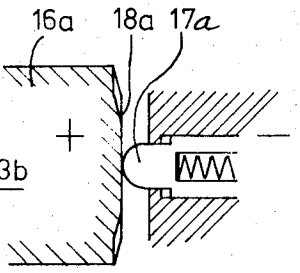


Fig 3b

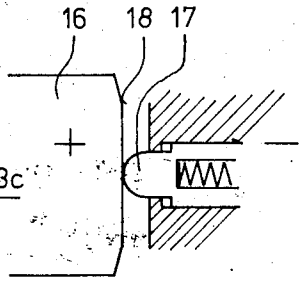
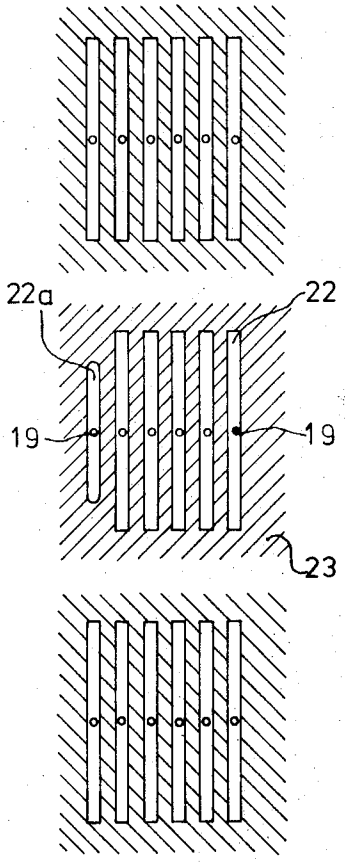


Fig 3c

Fig 5



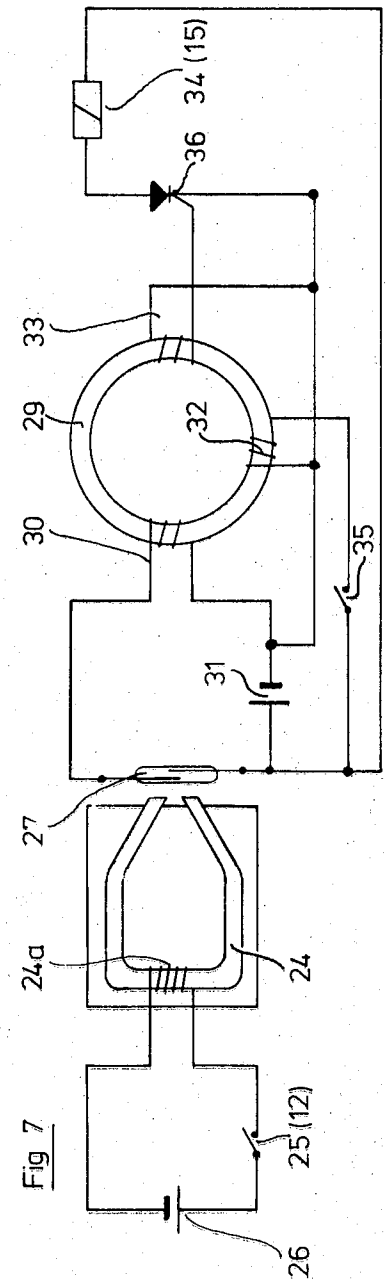


Fig 7

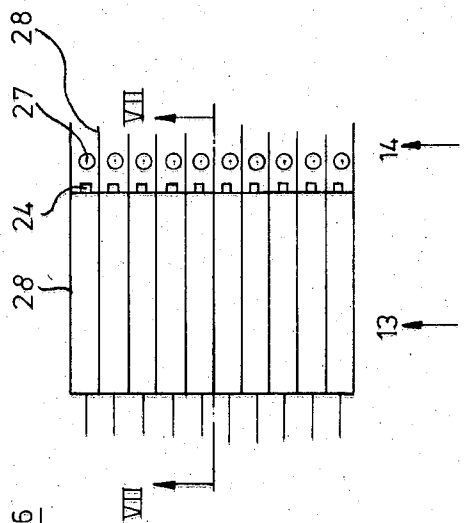


Fig 6

METHOD AND ARRANGEMENT FOR TRANSMITTING CONTROL SIGNALS TO THE CARRIAGE OF A FLAT KNITTING MACHINE

FIELD OF THE INVENTION

This invention relates to a method of and an arrangement for transmitting signals from a stationary program carrier to the machine carriage of a flat knitting machine for the purpose of controlling the movement and setting of this carriage.

BACKGROUND AND SUMMARY OF THE INVENTION

Carrier frequency methods have already been proposed for the transmission of needle control data for patterning. One such prior method has involved a signal transmission by radio in an elongated Faraday cage disposed along the path of the machine carriage. Another method has used a Laser beam directed along the carriage path and serving as a carrier wave.

In contrast, in the method of the present invention signals require to be transmitted to the machine carriage at predetermined periods only.

Hitherto it has been usual to control the carriage of an automatic flat knitting machine by a mechanical system incorporating a slide which is actuated by abutments provided at the carriage reversal locations. A slide control mechanism of this kind can also be provided with a pre-selector means which comes into effect at the central part of the stroke of the carriage and which, by run-on cams, permits an impactless reversal of the carriage at the ends of its stroke. Electromagnetically operable carriage control systems have also been proposed in which the cams and the means for operating the thread guides are adjusted by electromagnets. In this case, the electrical energy and the control impulses are transmitted to the carriage from a stationary control through the medium of trailing cables.

The control systems hitherto devised are all deficient when it is required to change from a conventional individual control of a flat knitting machine to the control of a plurality of such machines from a central program carrier. A central control of this character has the advantage that it dispenses with the known forms of cards so that program carriers such, for example, as punched tapes taking up less room, can be used. In this case it is of great advantage to adopt a means utilizing an electronic control technique for controlling the machine carriage.

Accordingly, the object of this invention is to develop methods of, and apparatus for, the transmission of electrical control impulses from a stationary program carrier to the movable machine carriage without the use of a trailing cable, and with provision for adjustment of the carriage stroke. A particular aim is substantially to reduce the outlay required in connection with the known mechanical carriage control means to obtain an accurate length of carriage stroke.

A method for this purpose according to the present invention is characterized by the fact that the control of the machine carriage is performed from a central program carrier which is responsible for a plurality of machines, the program data being transmitted, preferably through a plurality of channels, to the carriages at predetermined intervals by means of signal transmission arrangements which either use physical contact closure, or are contactless. The signal transmission to the carriage can either take place at the ends of the carriage stroke without any storage of signals, or can take place at a predetermined time between the ends of the carriage stroke, in which case the transmitted signals will at least partly be stored on the carriage up to the end of a carriage stroke.

The method according to the invention can be implemented by arrangements in which the stationary signal emitters are either in the form of electrically conducting contact bars, stationary light conductors or slotted diaphragms, arranged in the direction of travel of the carriage, or by controllable magnetic field-inducing means, which are effective along the path of travel of the carriage. Associated with the stationary signal emitters are movable signal receivers which may conveniently be in the form of contact brushes or pins connected to the carriage and arranged to wipe over the stationary contact bars. Alternatively, the movable signal receivers may be in the form of photoelectric converters carried by the carriage; or they may even be in the form of reed contacts suitably associated with the carriage. By any of these means the stationary signal emitters are so devised as to be effective over a specific part of the carriage stroke, taking into account any possible variation in the length of said stroke. Optical signal emitters are provided with a lineal signal emitting area opposed to a point-form photoelectrical converter connected to the carriage and acting as a receiver or conductor. The signal emitters of the signal transmission over a predetermined section of length of the machine are advantageously assembled in a group, thus keeping the space requirements of the transmission arrangement to a minimum.

The signal emitters may advantageously have arranged thereover a similar signal emitter which determines timing of the transmission and the effective length thereof in the longitudinal direction, and the carriage travel is fore-shortened relatively to the effective working range of the other signal emitters, preferably at both ends of this travel. This ensures that the signal transmission will only be initiated when signal emitters and signal receivers already confront one another, and that the signal transmission will be terminated while this confrontation still applies. Where a signal transmission utilizing physical contact is employed, this facility ensures that current will only pass after the physical contact has been made and will be terminated before this contact is broken, thus avoiding any contact opening with the contacts energized and consequent arcing.

The storage of the transmitted signals on the carriage can, for each signal transmission channel, be catered for by at least one magnetic storage core with a storage coil, a signal input coil and a signal output coil connected to an electrically operating member.

DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood and readily carried into practical effect, specific examples of the improved control signal transmission arrangement will now be described with reference to the accompanying diagrammatic drawings, wherein,

FIG. 1 is a wholly diagrammatic general view of a signal transmission arrangement on a flat knitting machine,

FIG. 2 is a section, taken transversely to the longitudinal direction of the machine, through the transmission part of the arrangement designated S in FIG. 1,

FIGS. 3*a* – 3*c* are diagrammatic sections taken respectively on the lines III*a* – III*c* of FIG. 2,

FIG. 4 is a plan view, partly in section, of the transmission zone S in a modified arrangement,

FIG. 5 is a section taken on the line V—V of FIG. 4,

FIG. 6 is a diagrammatic cross section, corresponding to FIG. 2, through yet another embodiment of the signal transmission arrangement, and

FIG. 7 is a section taken on the line VII — VII of FIG. 6 with the addition of an associated electrical switching circuit.

In FIG. 1, the numeral 10 designates a part of the frame and the numeral 11 the carriage of a flat knitting machine. The machine carriage 11 is controlled by a stationary program carrier 12, for example in the form of a punched strip. The program carrier 12 is electrically connnected to a plurality of stationary signal emitters 13 combined in a group and secured to the machine frame 10. The stationary signal emitters 13 co-operate with movable signal detectors 14 supported from the carriage 11, and these detectors are in turn electrically connected to operating members 15 arranged on the said carriage. In FIG. 1 the stationary signal emitters, the movable signal detectors and the operating members 15 have in each case been shown purely diagrammatically in the form of boxes. A signal transmission zone S, over which the signal transmission can be performed in different ways, is arranged between the stationary signal emitters 13 and the movable signal receivers 14.

FIG. 2 is a section, taken transversely to the longitudinal direction of the flat knitting machine, through the signal transmission zone S in the case of a signal transmission arrangement relying on the use of mutually engageable contacts.

In FIGS. 3*a* – 3*c* the stationary signal emitters 13 comprise a plurality of mutually insulated electrical contact bars 16 which are arranged in a block one above the other, while the signal receivers 14 which are connected to the machine carriage 11 and travel therewith are in the form of spring-urged contact pins 17. The latter are also arranged in a block one above another in a similar way to the contact bars 16, each such contact pin 17 co-operating with one of these bars. The contact surface 18 of each of the contact bars 16 extends over a short length only of the stroke of the carriage. That is to say, this surface extends not over the complete length of the needle bed of the flat knitting machine, for the reason that no continuous signal transmission is necessary to control the carriage but only one which is effective at predetermined times. Located between the contact bars 16 is a contact bar 16*a* which, by contact with its associated pin 17*a*, controls the feed of signals from the stationary program carrier 12 to the contact bars 16 and is distinguished by a contact suface 18*a* which is foreshortened at the two ends. Accordingly, contact is made between the contact bar 16*a* and its associated contact pin 17*a* only when all the remaining contact pins 17 have already made contact with their associated contact bars 16, and the contact between pin 17*a* and bar 16*a* is interrupted while the remaining pins 17 are still in contact with bars 16. This prevents arcing when the pins 17 first run onto and also when they leave the bars 16.

The signal transmission from the programm carrier 12 to the machine carriage 11 may, however, be performed without any physical contact being made. Thus, FIG. 4 is a diagrammatic plan view of the signal transmission zone S in an arrangement which incorporates an optical signal transmission and in which the stationary signal emitters 13 comprise slotted diaphragms 22 (FIG. 5) which are in each case illustrated either by a small rod illuminator or by a small light-conducting rod with incidences of light in the axial direction and emergence over the complete longitudinal side, or by light conductors with area-varying means, these slotted diaphragms 22 having associated therewith photocells 19 connected to the machine carriage 11. In this embodiment the photocells represent or constitute the signal detectors 14. The light can be transmitted from the program carrier 12 to light strips 20 at the transmission zone S through the agency of flexible light conductors 21 of a known form comprising a plurality of strands of glass fibers, these light conductors, which are of circular cross section, being so deformed and widened at their ends 21*a* as to provide the light strips 20. As can be seen from the sectional illustration of FIG. 5 the light strips 20 are effective over the slotted diaphragms 22 which are superimposed on a signal transmitter block 23 and are each associated with an aligned photocell 19 on the carriage. One of the slotted diaphragms, designated 22*a* is shorter than the remainder. The corresponding light strip produces a control signal in the associated photocell 19 and this is only effective when the photocells 19 associated with the other slotted diaphragms 22 have already responded to light.

FIG. 6 shows a block of stationary signal emitters 13 and an associated block of movable signal receivers 14 which define the transmission zone S of an arrangement for an inductive signal transmission.

In FIG. 7 the stationary signal emitters are constituted by electromagnets 24 energized from the program carrier 12, the latter being symbolized in this figure by a switch 25 located between a battery 26 and the energizing coil 24a of the electromagnet 24. The movable signal receivers in this arrangement are constituted by reed contacts 27 each of which is controlled in known fashion by the magnetic field generated by excitation of the associated electromagnet 24. To prevent any action on the individual reed contacts 27 by non-associated electromagnets adjoining the same in the signal emitter block, screens 28 arranged between the individual magnets extend up to the zone occupied by the reed contacts 27. A plurality of signal emitter blocks may, if desired, be arranged one behind another.

The reed contacts 27 may be arranged directly to activate electromagnetic or electromotor operating members 15 arranged on the carriage 11. The signals transmitted by the electromagnets 24 at a specified section in the carriage stroke may alternatively be stored, until required, in a magnetic memory core 29 on the carriage. To this end, each of the reed contacts 27 is connected to a direct current source 31 arranged in series with a signal input coil 30 of the relevant magnetic memory core 29, all as shown in FIG. 7. Each magnetic memory core 29 also has an on-call coil 32 and a signal output coil 33. The coil 33 is connected to an electrical switching means 36, preferably in the form of a transistor or thyristor. This electrical switch 36 controls an electromagnet operating member 34 representative of the aforementioned operating members 15. The on-call

coil 32 is in circuit with a switch 35 which may, for example, be operated either mechanically by a stationary abutment at the end of the carriage travel, or electrically by a proximity switch.

When an electromagnet 24 is energized in the signal transmission zone S the corresponding reed switch 27 is closed and a signal sent to the carriage 11. This closure of the reed switch 27 causes a flow of current through the signal input coil 30 of the magnetic memory storage core 29 which is in its rest condition (negative retentivity), and the core switches over to its operating condition (positive retentivity). It stays in this operating condition even after the subsequent opening of the reed switch 27 and in this way stores the imparted information. The operation of calling for this information has a starting signal at the electromagnet 24 and through the signal output coil 33 is performed by closing switch 35 and sending a resultant flow of current through the on-call coil 32 of the magnetic storage core 29. This current flow results in return of the magnetic storage core to its rest condition as a consequence of which a voltage in the output coil 33 in induced. In turn this voltage activates a thyristor 36 which controls the circuit in electromagnet operating member 34.

One of the signal emitters and its associated signal receiver may also be used in the signal transmission arrangement illustrated in FIG. 6 for controlling the signal transmission to the remaining transmitting members.

We claim:

1. In a flat knitting machine, an arrangement for the transfer of carriage movement and setting signals from a central stationary program carrier, comprising stationary signal transmitters aligned in the direction of travel of the carriage, and signal receivers attached to and movable with the machine carriage, said stationary signal transmitters comprising relatively linear optical signal transmitters, and said signal receivers comprising relatively point-form photo-electric converters carried by the machine carriage.

2. Flat knitting machine according to claim 1, wherein said stationary signal transmitters comprise illuminable slit apertures extending in the direction of travel of the carriage, and means for illuminating said slit apertures.

3. Flat knitting machine according to claim 1 further comprising a superposed similar signal transmitter cooperating with said stationary signal transmitter for determining the time period of signal transmission, the effective length of said similar signal transmitter being shortened in the longitudinal direction of the path of the carriage as compared to the effective length of the other signal transmitters.

4. Flat knitting machine according to claim 1 wherein the signal transmitters are arranged in groups in a signal transmitting zone limited to a certain longitudinal range of the machine less than the length of the needle bed.

5. Flat knitting machine according to claim 1 wherein said stationary signal transmitters comprise stationary light strips disposed in the direction of carriage travel as lineal signal transmitters for optical signal transmission.

6. Flat knitting machine according to claim 5 wherein light is transmitted from said program carrier to said light strips by flexible light conductors.

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