

[54] **CONTROL PULSE SYSTEM FOR KNITTING MACHINES**

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[58] **Field of Search**..... 66/50 R, 50 A, 50 B, 66/25, 154 A, 56

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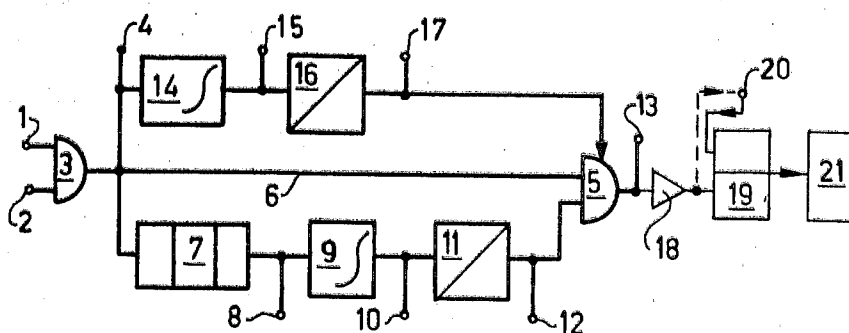
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[57] ABSTRACT

In a knitting machine with electromagnetic selection of the needles, excitation of the electromagnets is controlled by pulses at the revolutions per minute (speed) of the machine. The time constant of the electromagnets at high machine speeds is compensated by shifting the phase of the pulses in accordance with the machine speed. Phase shift at low speeds is unnecessary.

2 Claims, 4 Drawing Figures



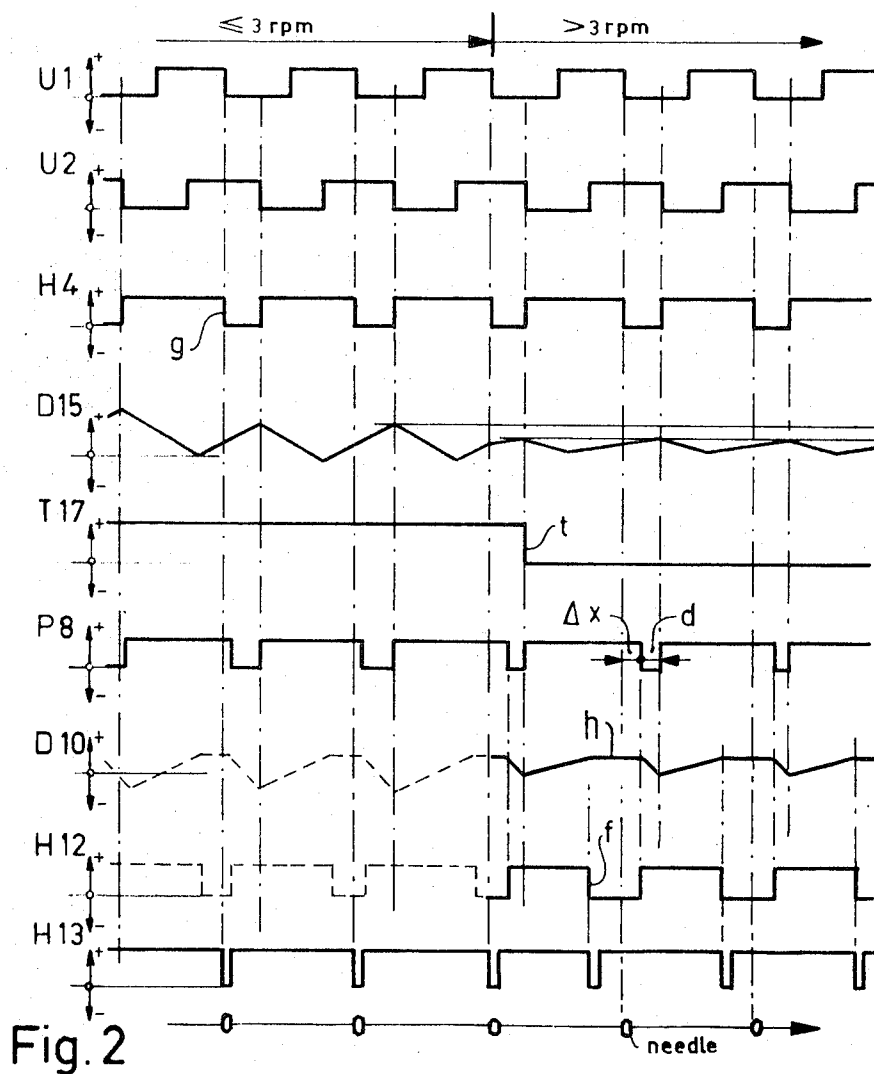
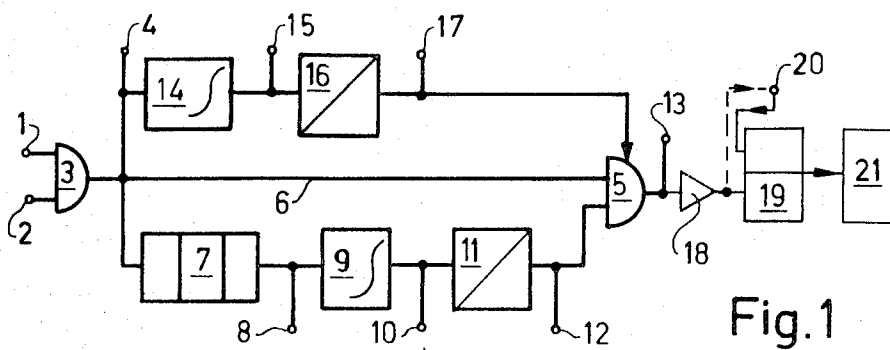


Fig. 3

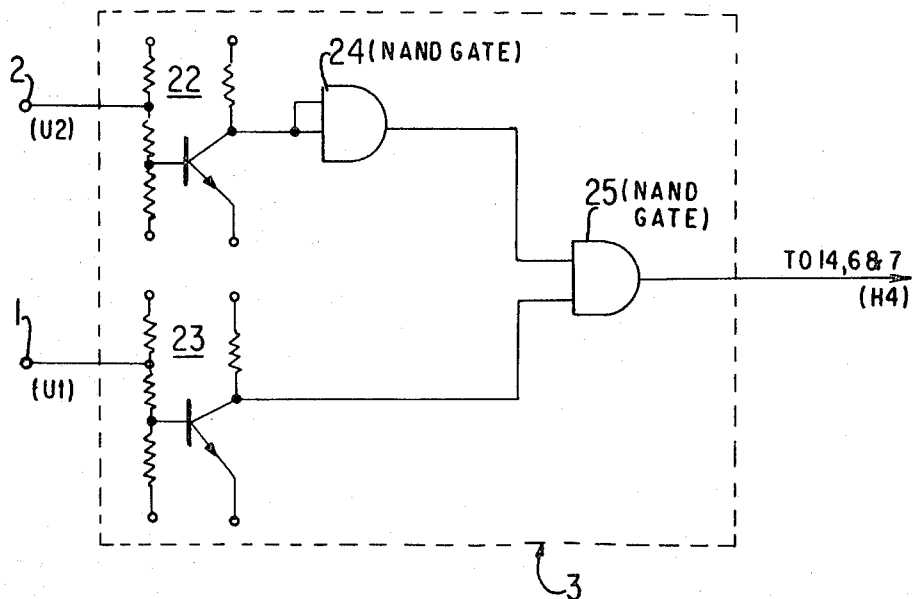
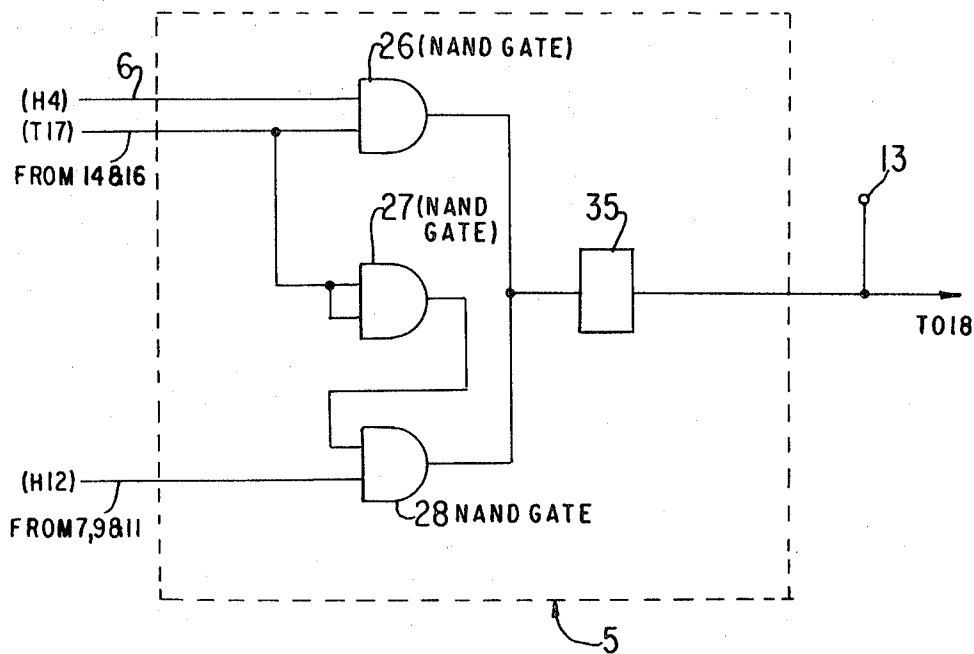


Fig. 4



CONTROL PULSE SYSTEM FOR KNITTING MACHINES

This invention relates to a generator of pulses with phase displacement (abbreviated in what follows to 'phase shifter'), which generator initiates, in a knitting machine with electromechanical selection of the needles, the carrying out of control orders originating in another source, the shift time being a function of the speed of the knitting machine, and the knitting machine driving a pulse generator which is electrically connected with the phase shifter.

BACKGROUND OF THE INVENTION

The electromechanical needle selection in a knitting machine is effected by electromagnets, which select push rods or other ferromagnetic parts, which in turn act on the needles. The excitation of the electromagnets is effected by electrical impulses which are read from a program by means of a reading device (termed "another source"). The magnets have their own particular time constant and are affixed to a machine with which they must act synchronously. The speed of the machine varies between zero and a maximum value. This fixed time constant must be compensated by causing the impulses to act on the electromagnets as early as is necessary to obtain the mechanical effect at the correct moment. For this purpose a phase shifter has previously been proposed (Swiss Patent 410.123) (U.S. Pat. No. 3,470,714 Corbaz) which generates three pulse sequences displaced in respect of one another and assigns a given pulse sequence to a range of machine speeds. This proposal offers a perhaps sufficient, but in no way optimum solution, to the problem, since in each range the control orders are released at the optimum time only for a single speed of the whole range of speeds.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a phase shifter which releases the control orders for all possible machine speeds, with the exception of the minimum speeds, at the quasi-optimum point of time.

For low speeds a compensation is unnecessary, as the time constant of the electromagnets is substantially less than the travel time of the push rods before them. Because of this, the phase shifter can be substantially simplified.

The phase shifter in accordance with the invention is characterized in that a logical system adapting pulses coming from the pulse generator is connected to two circuits, one of which, for the low speeds, connects the adaptive logical system direct to a change-over and shaping logical system, while the other, for the higher speeds, connects the adaptive logical system via a delay circuit, a first integrator and a first Schmitt trigger to the change-over and shaping logical system, and in that the changing-over from one circuit to the other, which is effected by the change-over and shaping logical system, is controlled by a tachometer circuit containing a second Schmitt trigger, which is controlled by a second integrator.

THE DRAWINGS

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawing, in which:

FIG. 1 is a block diagram of the phase shifter, and

FIG. 2 shows the shape of the pulses at different terminals of the phase shifter, the abscissae representing the geometrical position of the needles on the machine.

FIGS. 3 and 4 show ways of implementing the portions 3 and 5 respectively of FIG. 1.

PREFERRED EMBODIMENT

Input terminals 1, 2 of an adaptive logical system 3 are electrically connected to a pulse generator (which may be of any known type and is therefore not described in more detail) fixed on the knitting machine, or frame. The said pulse generator produces two cyclic pulse sequences U_1 , U_2 , which are electrically displaced in respect of one another by 90° , the first sequence being fed to the terminal 1 and the second sequence to the terminal 2. The adaptive logical system 3 changes the cyclic relationship of the pulses. The form, which can be determined at the terminal 4, is represented by the pulse sequence H_4 .

As one skilled in the art will readily perceive, the adaptive logical system 3 may be constructed as shown in FIG. 3. In FIG. 3, conventional transistor circuits 22 and 23 impose the pulse sequences U_1 and U_2 from inputs 1 and 2 on NAND gates 24 and 25 as shown, NAND gate 24 being connected as inverter. In a conventional manner, npn-transistors 22, 23 amplify pulse sequences U_1 and U_2 , respectively, and invert their logic. NAND gate 24 inverts again the logic of inverted U_2 for input to NAND gate 25 so that NAND gate 25 having the pulse sequence U_1 with inverted logic and the pulse sequence U_2 at its inputs may produce H_4 as an output.

The adaptive logical system 3 is connected via two circuits with the output side of the phase shifter. The said output side is a change-over and shaping logical system 5, herein referred to as an output logical system 5, for short.

The first circuit, for low speeds, is a direct connection arrangement, effected by a connecting line 6. In the present embodiment by "low speeds" are meant speeds from zero to three revolutions per minute of the needle cylinder, and by "higher speeds" are meant speeds of more than three revolutions per minute.

In the second circuit, for the higher speeds, the adaptive logical system 3 is connected to a delay circuit 7 which delays the descending flanks of the pulses of the pulse sequence P_8 , terminal 8, in relation to the descending flanks of the pulses H_4 by a time interval Δt (represented by a length Δx).

It is advantageous to provide an adjustable delay circuit 7, in order to obtain a single embodiment for different types of knitting machines and various needle distributions.

The delay circuit 7 is connected to an integrator 9, which works with constant current strength. The said currents generate a cut-off saw-tooth voltage which is represented by the sequence D_{10} , terminal 10. During the time (represented by the length d) for which a pulse of the sequence D_{10} lasts, the voltage decreases at a constant rate, and at the end of this pulse it increases at a different constant rate. It is known to obtain rates (graph gradients) of this kind by charging/discharging a capacitor at constant currents. The constant voltage represented by the horizontal line h between two saw-teeth, is used for controlling a Schmitt trigger 11. The pulse sequence occurring at the output side (terminal 12) of the trigger 11 is represented by H_{12} . The said

output is connected to the output logical system 5, which latter, controlled by the flanks f , generates calibrated pulses. These are represented by the pulse sequence H_{13} , terminal 13.

The output logical system 5 changes over from one circuit to the other. In order to do this it is controlled by a tachometer circuit. The latter utilizes the pulses of the sequence H_4 to determine the machine speed and to generate a corresponding shift signal. This signal is shown in graph T_{17} , terminal 17. The moment of shifting is shown by the flank t . The tachometer circuit comprises an integrator 14 with constant current, which generates a variable voltage represented by the graph D_{15} , terminal 15. If this voltage does not reach a predetermined limit value, that is when the machine speed is greater than the mentioned value of three revolutions per minute, then a Schmitt trigger 16 changes its condition. The said trigger is connected to an integrator 14 and its condition is represented by the graph T_{17} , terminal 17.

As one skilled in the art will readily perceive, the output logical system 5 may be constructed as shown in FIG. 4. The output logical system 5 of FIG. 4 is formed by NAND gates 26, 27 and 28, and pulse shaping circuit 35.

At speeds below 3RPM, NAND gate 26 has inverted H_4 as an output. At speeds above 3RPM, the output of NAND gate 26 is not inverted H_4 but a constant value. Conversely, at speeds below 3RPM, NAND gate 28 has a constant output, while above 3RPM, NAND gate 28 has inverted H_{12} as an output. As is obvious to one skilled in the art, the combined output of NAND gates 26 and 28 is, therefore, inverted H_4 at speeds below 3RPM and inverted H_{12} at speeds above 3RPM. The foregoing is in accordance with the conventional NAND gate logic and takes into account the fact that NAND gate 27 inverts T_{17} .

Pulse shaping circuit 35 is well within the skill in the art and converts the H_4 and H_{12} outputs of NAND gates 26 and 28 into H_{13} .

The NAND circuits of FIGS. 3 and 4 are preferred because of their well known reliability and inexpensiveness (compared to older switching techniques which would perform the functions of elements 3 and 5 of FIG. 1).

It is obvious to one skilled in the art that Schmitt trigger 16 may be operated from one to the other of its two states indicated by T_{17} simply by monitoring the peak values of D_{15} . It is very old in the art to sample a signal

for its peak value by means of a sampling pulse occurring at the time of each peak value. It is evident from FIG. 3 that the peak values of D_{15} occur at the time of the trailing edges of H_4 and it lies within the skill of the art, indeed it is obvious, to derive the required sampling pulses from H_4 . Since the peak values of D_{15} before 3RPM are distinctly different from those above 3RPM, as indicated by the horizontal lines at peak levels, these values may be used for operating the Schmitt trigger 16 from one or the other of its two states indicated by T_{17} .

At low speeds the output logical system 5 utilizes the flanks g of the pulse sequence H_4 for releasing the calibrated pulses of the sequence H_{13} .

The calibrated pulses coming from the phase shifter are amplified in an amplifier 18, and by means of a storage device 19, they control the further conductance of the programme pulses, the "control orders" which originate from another source 20, to the electromagnets of the knitting machine 21. The source 20 may be a programme reader, a data processing unit, or the like.

The calibrated pulses can further control the step-by-step conveying of the programme carrier and/or the moment for reading off the same and/or the moment for reading information from a store.

I claim:

1. A generator of pulses with phase displacement which initiate in a knitting machine with electromechanical needle selection the carrying out of control orders originating from another source, the amount of the phase displacement being a function of the speed of the knitting machine, which machine drives a pulse generator which is electrically connected with the generator of pulses with phase displacement, characterized in that an adaptive logical system including gates combining and adapting the pulses coming from the pulse generator, is connected to two circuits, one of which, for low speeds, connects the adaptive logical system directly with a change-over and shaping logical system including gates, and the other of which, for the higher speeds, connects the adaptive logical system via a delay circuit, a first integrator, and a first trigger with the change-over and shaping logical system and so that the changing-over from one circuit to another, which is effected by the change-over and shaping logical system, is controlled by a tachometer circuit comprising a second trigger, which is controlled by a second integrator.

2. A generator as claimed in claim 1, wherein the delay circuit can be regulated.

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