AUTOMATIC STOP MOTION FOR KNITTING MACHINES AND THE LIKE


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13 Claims. (Cl. 66—165)

This invention relates to automatic stop motions for knitting machines and the like, and more particularly to a stop motion device operable by the vibration of the strand on which a textile covering is being applied by a knitting machine, or the like.

In general, knitting machines consist of a plurality of knitting needles which are simultaneously reciprocated and rotated so as to combine a plurality of textile threads into a tubular knitted web. This knitted web is utilized in many ways, one of the more common being to apply it as a textile covering around a continuously advancing conductor. Some of the limiting factors in operating knitting machines are the breaking of one or more of the threads being engaged by the needles, the breaking of one or more of the needles or the occurrence of a dropped stitch during a knitting operation. When any of these conditions occurs, a defective covering is knitted on the conductor and it is desirable to stop the knitting machines upon the occurrence of the faulty knitting operation of the machine.

An object of the invention is to provide new and improved stop motions for automatically stopping knitting machines and the like upon the occurrence of a faulty knitting operation.

Another object of the invention is to provide a stop motion device arranged to promptly stop a knitting machine upon the occurrence of a broken thread, broken needle or the dropping of a stitch.

A further object of the invention is to provide a stop motion device arranged to automatically stop a knitting machine, or the like, upon excessive vibration of the filamentary core upon which the knitting operation is being performed by the machine.

One apparatus embodying features of the invention comprises a potential generating element arranged to be engaged by an advancing core upon which a knitted tubular covering is being applied so that when the conductor is caused to vibrate out of its normal path of travel due to a faulty knitting operation, a potential is generated thereby which is utilized to effect an immediate stoppage of the knitting machine.

Other objects and advantages of the present invention will be apparent from the following detailed description of a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary, sectional view of the knitting mechanism of a conventional knitting machine disclosing a stop motion device embodying this invention applied thereto;

Fig. 2 is an enlarged sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is an enlarged section taken along line 3—3 of Fig. 1 showing a potential generating element, which is engaged by a core being advanced through the knitting mechanism shown in Fig. 1;

Fig. 4 is a fragmentary, sectional view taken along line 4—4 of Fig. 1;

Fig. 5 is a schematic wiring diagram of the electrical apparatus arranged to utilize the potential generated by the generating elements shown in Figs. 1 to 4, inclusive, to effect a stoppage of the knitting machine, and

Fig. 6 is a vertical, sectional view of an alternate design of a potential generating element arranged to be actuated by excessive vibration of a core being advanced through a knitting mechanism such as is shown in Fig. 1.

Referring now to the drawings, reference numeral 10 designates a conventional gear box forming part of a knitting machine, which is arranged to rotate a hollow tubular shaft 11 and a jack cylinder 12 forming part of a conventional knitting mechanism indicated generally at 13. The knitting mechanism to which this invention is applied is disclosed in detail in B. W. Lerch, et al., Patent 2,236,169 and S. E. Ballhirt Patent 2,290,578, and only as much of this mechanism is disclosed and described hereinafter as is necessary for a full understanding of the present invention.

A pair of wobbler cams 14—14 are secured angularly on the shaft 11 so that when the shaft 11 is rotated, they serve to reciprocate a plurality of needle jacks 15—15 slidably positioned in slots 16—16 provided in the jack cylinder 12. A sleeve 17 is fitted around the jack cylinder 12 so as to provide a suitable bearing surface for the needle jacks 15—15 as they are reciprocated. Each of the needle jacks 15—15 serves to reciprocate a knitting needle 20 alladly mounted in a slot 21 provided in a needle cylinder 22 secured to the jack cylinder 12 so that the slots 21 and 16, respectively, are aligned vertically with respect to each other.

The jack cylinder 12 and the shaft 11 are rotated in the same direction but at different speeds so that each of the knitting needles 20—20 will be reciprocated a predetermined number of times per revolution of the needle cylinder and the jack cylinder. The ratio of the speed between the jack cylinder 12 and the wobbler cams 14—14 depends upon the total number of knitting needles 20—20 embodied in the knitting mechanism 13, and the number of threads being employed in the knitting operation. One of the more common kni—
A knitting mechanism having fourteen knitting needles 20–29 equally spaced around the needle cylinder 22 (Fig. 2) operating upon six textile threads, such as threads 23–23 (Fig. 1).

In a normal knitting operation, it is customary for each needle to engage each thread once during each complete revolution of the knitting needle. If the above-mentioned arrangement of needles and threads were employed, each needle must make six complete reciprocations per revolution of the jack cylinder and needle cylinder.

In the operation of the knitting mechanism 13, the textile threads 23–23 are drawn from suitable supply cops (not shown) and pass through their respective guides like the guides 24 mounted on a thread guide spindle 25 adjacently mounted on a support 26 forming part of the knitting machine. Each of the threads 23–23, after passing through its respective guide 24, is passed around a guide 27 positioned adjustably on the support 28 immediately above and concentric with the knitting needles 20–29. In this manner, the threads 23–23 are fed to the knitting needles 20–29 from a plurality of equally spaced points about a circle in a symmetrical pattern and, upon rotation of the wobbler cams 14–14 and the jack cylinder 12, the needles engage the threads 23–23 and form a conical, tubular web 30.

A filamentary core 31, such as an insulated conductor, is advanced through a central aperture provided in the needle cylinder 22, the jack cylinder 12 and the shaft 11 at a constant rate of speed by a suitable capstan (not shown). The knitting mechanism 13 serves to apply the tubular web 30 tightly around the advancing core to form a textile covering 32 thereof. A guide 33 is secured on the support 26 for the purpose of maintaining the path of travel of the core 31 substantially central with respect to the knitting needles 20–29. Due to the fact that the needles 20–29 are equally spaced around the needle cylinder 22 and the threads 23–23 are fed to the knitting needles in a symmetrical pattern, the core 31 will travel in a substantially centralized path through the knitting mechanism 13. Such an arrangement of the knitting needles 20–29 and the threads 23–23 produces, under a normal operation of the mechanism 13, an equal tension at all points around the web 30, thereby causing the core to pass through the knitting mechanism without oscillating in any direction, except for the normal vibration inherent in the knitting machine.

However, in the event of a broken thread, a broken needle or a dropped stitch, the symmetrical pattern of the knitting operation being performed by the knitting mechanism 13 becomes unbalanced, resulting in an unequal pull at some point around the web 30. When such an unbalanced knitting condition occurs around the web 30, the web and the core on which it is being formed are caused to oscillate at a relatively high frequency transversely to the vertical axis of the core and principally along an axis joining the strong side and weak side of the web 30. Due to the peculiar construction of the knitting mechanism 13, this oscillation of the web 30 and the core 31 may be in any one of a plurality of directions with respect to the rotary knitting operation of the knitting mechanism 13.

For example, should one of the threads 23–23 break, the knitting operation performed therewith terminates and the web 30 collapses as soon as all the needles associated therewith pass the broken thread. During the period in which the web 30 is collapsing because of the broken thread, the knitting operation becomes highly unbalanced, but this unbalanced condition remains fixed along one axis, with respect to the web due to the fact that the threads are not rotating.

Looking at Fig. 2, this fixed axis of oscillation may fall along the axis A–A, the axis B–B along an intermediate axis, depending upon which one of the threads 23–23 breaks. However, when a needle break or a dropped stitch occurs, the unbalanced knitting operation does not remain fixed with respect to the web but is propagated along the web with the needles, whereupon the core oscillates successively along many axes around the web.

When faulty knitting operations occur, a defective core is formed on the advancing core. Hence, it is desirable to effect a quick stoppage of the knitting machine before too great a length of the core contains a defective covering. The oscillating movement of the web 30 and the core 31 on the occurrence of a fault in the knitting operation is utilized in accordance with the present invention to arrest the movement of the knitting machine and the core automatically.

An eye 35 (Figs. 1 and 4) is formed on the end of a detector rod 36 so that the eye is directly within the core 31 being advanced through the knitting mechanism 13. The detector rod 36 is secured in a conventional potential generating crystal cartridge 37 by means of a thumb screw 38. While the crystal cartridge 37 may be of any well known design, one type particularly suitable for this purpose is the lever type cartridge Model W–56A manufactured by Shore Brothers, Incorporated, of Chicago, Illinois, and having a peak output voltage of 4.5 volts.

The crystal cartridge 37 is mounted on a plate 40 which is hingedly mounted on a support 41 by means of a pin 42. The support 41 is in turn pivotally mounted on the spider 28 by means of a pin 43. The pivot point of the support 41 on the spider 28 is arranged with respect to the central axis of the cartridge 37 so as to cause the cartridge 37 and the detector 36 secured therein to swing inwardly against the core 31 and to create a static pressure against the crystal element of the cartridge 37 commensurate with the operating characteristics of the cartridge. This arrangement provides for pivotal movement of the cartridge 37 in two directions, which maximizes the oscillation of the crystal element of the cartridge 37 and maximum potential output are obtained by the oscillations of the core 31 along the axis A–A to pivotally swing the spider 28 in substantially the same manner as described for the plate 40 supporting the cartridge 37.

Due to the inherent characteristic of the type of crystal potential generating element selected, the cartridge 37 is directional along the axis A–A and only the oscillations of the crystal element on this axis would produce full actuation of the crystal element to produce the rated output potential. Therefore, a second crystal cartridge 44 is mounted so as to be responsive to the oscillations of the core 31 along the axis B–B (Fig. 4). The cartridge 44 is identical with cartridge 37 and is mounted on a plate 45 which is hingedly mounted on a support 46. The support 46 is mounted pivotally on the spider 28 in substantially the same manner as described for the plate 40 supporting the cartridge 37.

A detector rod 47 is secured to the cartridge 44 in the manner described for securing the detector rod 36 to the cartridge 37. The detector rod 47 has an eye 48 (Fig. 1) provided on the
end thereof through which the core passes before entering the knitting mechanism 13. The crystal element of the cartridge 44 is also directional and therefore is fully actuated to provide maximum potential output only when the core 31 is oscillating along the axis A—A, while oscillating of the core along the axis B—B merely pivots the cartridge 44 about its pivot point on the support 46. However, when the core 31 oscillates along an axis intermediate the axes A—A and B—B, the resultant of the core B—B will actuate each crystal element a given amount, which, while somewhat less than full actuation will produce a combined potential sufficient for the purpose of the invention.

Each of the cartridges 37 and 44 is provided with a pair of terminals to which a suitable length of low capacity, rubber covered, shielded cable 50 (Fig. 5) may be connected. Each of the cables 50 is connected to a conventional, single stage amplifier-detector unit 51 having an operating coil 52 of a relay 53 connected in the output circuit thereof. The relay 53 is a sensitive D. C. relay commonly used in electronic tube circuits and is provided with a normally closed contact 54 arranged to be locked in the "open" position by a manually operated contact by the coil 52. The contacts 54 is connected in series with a manually operable snap switch 55, the contact 54 and the switch 55 serving to control the continuity of a control circuit arranged to supply potential to an operating coil 57 of a main line contactor 60. The contactor 60 is provided with normally open contacts 61—61, which upon energization of the coil 57 serve to connect a motor, indicated generally at 62 and used to drive the gear box 63 of the knitting machine, to a source of potential 65. The necessary operating potential of the detector amplifier unit 51 is also supplied from the power source 63.

When the knitting mechanism 13 is operating properly, the web 39 being formed thereby and applied around the core 31 advancing through the knitting mechanism will be substantially free of vibration, and the core will travel in a substantially centralised path through the knitting mechanism. In addition, a perfect covering 25 is formed on the core and substantially no lateral vibration or oscillation of the core is discernible. Hence, neither the crystal cartridge 37 nor the crystal cartridge 44 is actuated to the extent necessary to produce an output potential sufficient to cause stoppage of the machine.

However, when one or more of the threads 23—23 or needles 20—20 break, or when a dropped stitch occurs in the formation of the web 39 due to the breakage of a needle or other cause, a non-symmetrical knitting operation occurs which results in an unbalanced pull on the web 30. This unbalanced pull on the web causes the web to oscillate transversely of the central axis of the knitting mechanism 13. Since the advancing core 31 is supported at spaced points above and below the point of formation of the web by the knitting needles, the core 31 may be oscillated relatively easily. Therefore, this unbalanced knitting operation causes the core 31 to move laterally with respect to its vertical path of travel, which lateral movement automatically occurs along the axis joining the strong side and weak side of the web 39.

Assuming that the unbalanced knitting operation causes the core 31 to oscillate primarily along the axis B—B, the crystal element of the cartridge 37 is undergoing maximum displacement and generates its maximum output potential, while the cartridge 44 is merely swung about its pivot point. The output potential of the cartridge 37 is amplified by the amplifier detector unit 51 and is applied directly across the terminals of the coil 52 of the sensitive relay 53 thereby energizing the coil. Upon energization of the coil 52, the normally closed contact 54 of the relay is opened and becomes engaged by the manual reset arm 66. The operating coil 57 of the contactor 60 is energized the coil 57 of the contactor 60 and the contacts 61—61 disconnect the motor 62 driving the knitting mechanism from the source of power 65, whereupon the operation of the knitting machine is terminated.

Likewise, if the oscillations of the core 31 are primarily along the axis A—A, the crystal element of the cartridge 44 is undergoing maximum displacement and generates its maximum potential, which is applied across the input terminals of the amplifier-detector unit 51. The potential output of the cartridge 44 is amplified by the unit 51 and thereafter operates the relay 53 to disconnect the motor 62 from its source of potential in the same manner as that described when the cartridge 37 is actuated by the core 31.

However, the primary oscillations of the core 31 may occur along both axes intermediate the axes A—A and B—B. When such an oscillation of the core 31 occurs, it is directed by means of the detector rods 35 and 47 to the respective crystal elements of the cartridges 37 and 44. Each crystal element, upon being displaced a predetermined number of times per second by the oscillating core 31, generates a given voltage. Since neither of the crystal elements of the cartridges 37 and 44 is undergoing maximum displacement by such oscillation of the core, the voltage generated thereby is somewhat less than the maximum value of the elements. Nevertheless, since both of the cartridges are connected to the amplifier-detector unit 51, the combined potentials of the cartridges 37 and 44 will be sufficient, when amplified by the unit 51, to operate the relay 53 and stop the knitting machine in the above-described manner.

From the foregoing description, it will be evident that the knitting machine will be stopped automatically when the core 31 being advanced through the knitting mechanism 13 is oscillated in any direction by a faulty knitting operation resulting from a broken thread, a dropped stitch or a broken needle.

While in the above-described embodiment of the invention two crystal cartridges are employed to convert the mechanical vibrations of the core into electrical potential, it is obvious that three, four or more cartridges and associated detector rods may be disposed equidistantly around the core 31, as desired. The selection of the size and number of crystal cartridges to be used in a particular application depends upon the type of inputting operation being performed on the core, and the amplitude of the vibration upon the occurrence of a faulty insulating operation. Therefore, such modifications and changes may be made without departing from the spirit and scope of the invention.

Fig. 6 discloses another type of crystal pickup element arranged to be actuated by the oscillations of the advancing core 31 upon the occurrence of the faulty knitting operation. In this arrangement, a tube 70 is secured at one end thereof in the core guide 33 fastened to the sup-
port 26 forming part of the knitting machine.

The tube 70 is provided with an annular groove 71 which serves to form an inner ring 72 within the tube, which ring has an inside diameter somewhat smaller than the inside diameter of the tube, but somewhat larger than the outside diameter of the core 51 being advanced therethrough.

In the normal operation of the knitting mechanism 13, the core 51 will not contact the ring 72 as it is advanced through the tube 70.

A contact-type crystal microphone 73 is secured to the tube 70 so that mounting shoes 74—74 thereof engage the surface of the tube. The microphone 73 may be secured to the tube in any suitable manner, such as by a spring type clamp, by tapping it to the tube or by applying a suitable cement between the mounting shoes 74—74 and the surface of the tube. For the purpose of the present invention, the microphone 73 will be considered as being cemented to the tube 70 at the point where the shoes 74—74 contact the surface of the tube 70. The crystal generating element provided in the microphone 73 is connected to a suitable length of shielded low capacity cable 75. While various contact-type of microphones may be used in this manner, a particularly suitable type is known commercially as the “Vibromike,” (Model VM—1), manufactured by the Brush Development Company, of Cleveland, Ohio. This particular microphone has an output voltage of one volt per one thousandth of an inch displacement of the crystal at 500 CPS.

In the operation of the latter stop motion device, when a core 51 being advanced through the knitting mechanism 13 in a particular direction due to the occurrence of an unbalanced knitting operation, the core 51 in oscillating strikes the ring 72 of the tube 70 and sets up a vibration in the tube. This vibration is in turn picked up by the mounting shoes 74—74 of the microphone 73 and displaces the crystal element engaged by the mounting shoes so as to produce an output voltage across the terminals of the microphone. This output voltage of the microphone 73 is directed to an amplifier unit, such as the amplifier-detector unit 51 employed in conjunction with the crystal cartridges 31 and 56 described above. Thus, the output potential of the microphone is amplified by the unit 51 to sufficiently operate the sensitive D. C. relay 55 connected thereto, which in turn deenergizes the main contactor 60 and causes the knitting machine motor 52 to be disconnected from its source of power, whereupon the knitting operation performed by the knitting machine is terminated.

Since the contact-type microphone 73 is responsive to the mechanical vibrations set up in the tube 70 by the abnormal oscillation of the core in any direction, only one microphone is needed regardless of the direction of oscillation of the core with respect to the position of the microphone 73 or the tube 70. As long as the tube is caused to vibrate and the mechanical vibrations are sufficient to produce sufficient displacement of the crystal generating element of the microphone, its output voltage will be of a magnitude capable of being amplified and used to operate a sensitive relay to deenergize the motor driving the knitting machine.

While the above-described embodiments of the invention are directed to the use of a crystal type of potential generating element for converting the oscillations of the core into electrical energy, it is to be understood that a permanent magnet, moving coil type of potential generating element may readily be used to convert the oscillations of the core into suitable electrical energy which may be utilized in the above-described manner to terminate the operation of a knitting machine.

Although the above-described embodiments of the invention are particularly well adapted as stop motion devices for a knitting machine of the class described, they may be readily modified for use as stop motion devices for braiding, weaving, twining and like machines, without departing from the spirit and the scope of the invention as defined in the annexed claims.

What is claimed is:

1. In a knitting machine arranged to knit a tubular covering around a continuously advancing core which oscillates excessively upon the occurrence of a faulty knitting operation of the machine, a potential generating element arranged to be actuated by the oscillatory movement of the core, and means electrically connected to said potential generating element for effecting a stoppage of the knitting machine when a predetermined potential is generated by said element.

2. In a knitting machine arranged to combine a plurality of threads to form a tubular covering over a core being advanced therethrough which oscillates excessively when a defective covering is being applied to the core, a stop motion device which comprises a potential generating element, supporting means for urging the potential generating element into contact with the advancing core so that when the core oscillates excessively a potential is produced by said element, and means operable by the potential so produced for effecting a stoppage of the knitting machine.

3. A stop motion device for knitting machines arranged to combine a plurality of strands to form a tubular covering around an advancing core which is caused to vibrate more than a normal amount when a faulty knitting operation occurs, which comprises means for converting abnormal vibrations of the core in any direction into a predetermined electric potential, and means actuated by the electric potential so produced for effecting a stoppage of the knitting machine.

4. In a knitting machine arranged to knit a tubular covering around a continuously advancing core and including a motor for driving a stop motion device which comprises a plurality of potential generating elements arranged to be actuated only when the advancing core is caused to oscillate with an amplitude in excess of a predetermined amount, means for amplifying the potential generated by the oscillating core, and means controlled by the amplified potential for deenergizing the motor driving the knitting machine.

5. In a knitting machine arranged to combine a plurality of textile threads to form a tubular covering over a continuously advancing core whose amplitude of vibration is substantially increased above its normal amplitude of vibration upon the occurrence of an unbalanced knitting operation, a stop motion device which comprises a potential generating element arranged to be actuated only by vibratory motions of the advancing core, means for amplifying the potential generated by said generating element when the amplitude of vibration of the core exceeds the amplitude of its normal vibration, and means
operative by the amplified potential for terminating the operation of the knitting machine.

6. A stop motion device for knitting machines arranged to combine a plurality of threads to form a tubular covering on a conductor being continuously advanced therethrough, which comprises a pair of crystal type potential generating elements arranged to be actuated when the advancing core is caused to oscillate more than a predetermined amount in any direction by the occurrence of a faulty knitting operation, means for amplifying the resultant potential generated by the crystal elements when the core is oscillated, and means responsive to the amplified potential for terminating the knitting operation.

7. A stop motion device for knitting machines arranged to combine a plurality of threads to form a tubular covering around a core being continuously advanced therethrough which core oscillates excessively when a faulty knitting operation occurs, which comprises a pair of crystal type potential generating elements, an actuating rod secured to each potential generating element and adapted to engage the advancing core and secure the oscillation of the core to their respective crystal generating elements, said crystal potential generating elements being positioned so that their directional operating axes are disposed substantially 90° with respect to each other whereby they are responsive either singly or collectively to the oscillations of the core in any direction, means electrically connected to the potential generating elements for amplifying the resultant potential generated therein by excessive oscillation of the core in any direction, and means operative upon the generation of such a potential to effect a termination of the knitting operation.

8. A stop motion device for knitting machines adapted to combine a plurality of threads to form a tubular covering on a core being continuously advanced therethrough, which comprises a pickup cartridge having terminals and a crystal arranged to produce a predetermined potential across said terminals upon being actuated at high frequency, means for pivotally supporting the crystal cartridge adjacent to the advancing core, an actuator secured in the cartridge and having an eye in the end thereof for engaging the advancing core at a point adjacent to the point at which the tubular covering is formed thereon by the knitting machine, said actuator serving to transmit oscillations of the core to the crystal of said crystal cartridge and produce a given potential across the terminals thereof, an amplifier electrically connected to the crystal cartridge to amplify the potential generated by the crystal when the core is oscillating due to a faulty knitting operation, and a sensitive relay connected to the amplifier and arranged to be actuated by the amplified potential for effecting a stoppage of the knitting operation when the core oscillates.

9. A stop motion device for knitting machines arranged to combine a plurality of threads to form a tubular covering around an advancing core which oscillates excessively to its path of travel when a faulty knitting operation occurs, which device comprises an elongated tubular detector rigidly supported at one end so that the core may pass therethrough, said detector having a short bore formed therein of such size that it is engaged by the core when the core oscillates in any direction due to a faulty knitting operation thereby causing the tubular detector to vibrate, means secured to the tubular detector for converting the mechanical vibrations set up therein by the oscillating core into an electric potential, and means operable by such a potential for effecting a stoppage of the knitting operation.

10. In a knitting machine arranged to knit a textile covering around a continuously advancing core which oscillates excessively upon the occurrence of a faulty knitting operation of the machine, a potential generating element, means engaged by the advancing core for imparting to the potential generating element excessive oscillatory movements of the core in any direction to cause a potential to be generated by said element and means associated with the potential generating element for effecting stoppage of the knitting machine when a predetermined potential is generated by said element.

11. In a knitting machine arranged to combine a plurality of threads to form a tubular covering over a core advancing therethrough which core oscillates excessively when a defective covering is being applied to the core, a stop motion device which comprises a potential generating element, means engaged by the advancing core for imparting excessive oscillatory movement of the core in any direction to the potential generating element so that when the core oscillates excessively a potential is produced by said element, and means operable by the resulting potential for effecting stoppage of the knitting machine.

12. A stop motion device for knitting machines arranged to combine a plurality of strands to form a tubular covering surrounding an advancing core which is caused to vibrate more than a normal amount when a faulty knitting operation occurs, which comprises a potential generating element, means engaged by the advancing core for imparting vibrations of the core in any direction to the potential generating element whereby when the advancing core vibrates more than a normal amount a potential is generated by said element, means for amplifying the potential generated by the potential generating element, and means responsive to the resulting amplified potential for effecting stoppage of the knitting machine.

13. A stop motion device for knitting machines arranged to combine a plurality of threads to form a tubular covering around an advancing core which oscillates transversely to its path of travel when a faulty knitting operation occurs, which comprises an elongated tubular member rigidly supported at one end so that the core may pass therethrough, said tubular member having a bore formed therein of such size that it is engaged by the core when the core oscillates in any direction due to a faulty knitting operation thereby causing the tubular member to vibrate, a crystal microphone secured to the tubular member for converting the mechanical vibrations set up therein by the oscillating core into an electrical potential, and means operable by the resulting potential for effecting stoppage of the knitting machine.

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