June 21, 1955 A. EDELMAN ET AL 2,711,093

STOP MOTION

Filed June 25, 1949 2 Sheets-Sheet 1

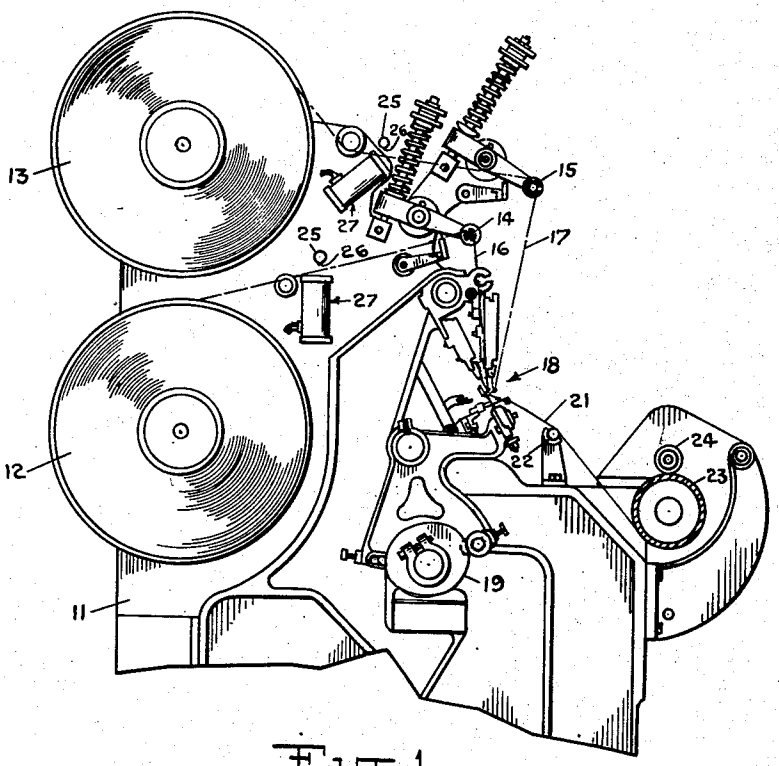


Fig. 1

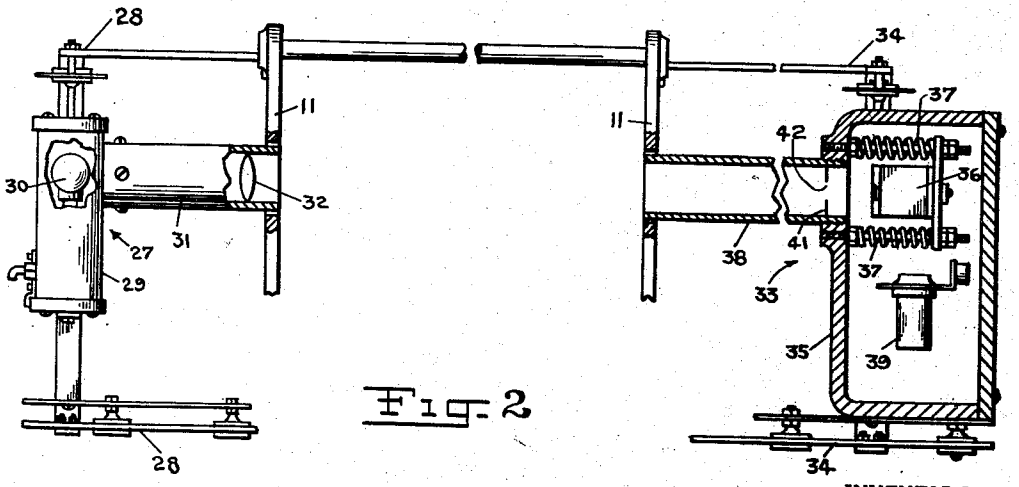


Fig. 2

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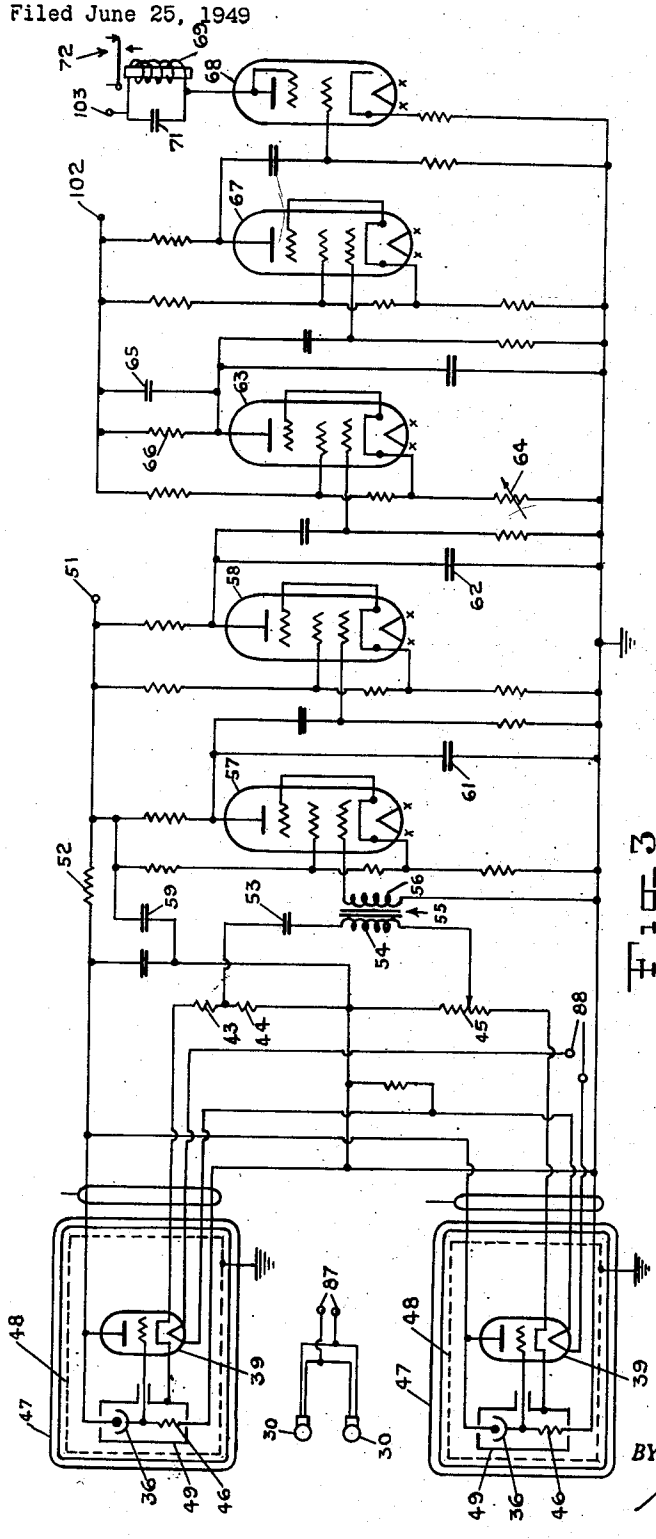


FIG. 3

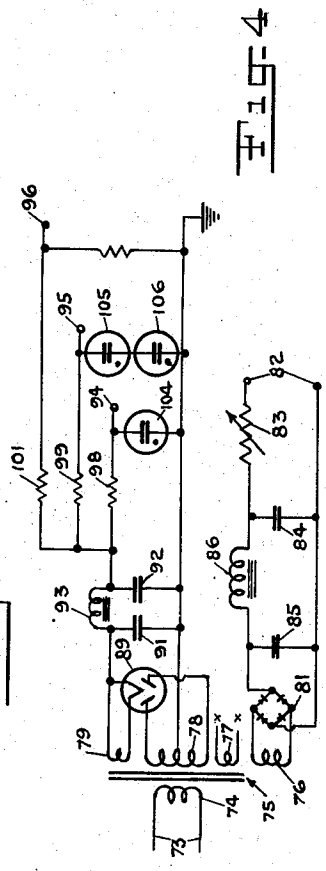


FIG. 4

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STOP MOTION

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15 Claims. (Cl. 66—163)

This invention relates to stop motions, and relates more particularly to photoelectric stop motions for warp knitting machines.

In textile machines wherein yarn is handled in the form of a warp, it is desirable to provide a stop motion which will give a warning or stop such machines upon breakage of a warp yarn, whereby the production of fabrics or other textile materials containing defects is substantially prevented. Mechanical stop motions, in which a drop wire is provided to ride on each of the warp yarns, have come into widespread use with certain types of textile machines, such as looms, having a relatively small number of yarns in each warp. However, mechanical stop motions are not suited for other types of textile machines, such as warp knitting machines having several thousand yarns in each warp, because of the lack of sufficient space for the requisite number of drop wires and because of the additional expense involved in positioning said drop wires when starting the machine.

It has previously been proposed to equip textile machines, such as warp knitting machines, with photoelectric stop motions which would give warning or stop the machine when a broken yarn passed through a beam of light impinging upon a phototube connected to a suitable amplifier. However, these photoelectric stop motions have not been satisfactory and have, therefore, not come into commercial use. When these photoelectric stop motions were made sufficiently sensitive to respond to the passage of a single yarn having a diameter of the order of 0.004 inch, or less, through the light beam, they would often respond to spurious signals when none of the yarns was broken. For example, electrical surges produced by the starting and stopping of other machines, line voltage fluctuations, mechanical shocks and vibration, and particles of dust and lint would cause the photoelectric stop motions to operate. In addition, frequent readjustment of the photoelectric stop motions was required to compensate for the ageing of the light source and the tubes in the amplifier, which ageing reduced the intensity of the light beam and altered the effective sensitivity of the amplifying circuit. On the other hand, if the sensitivity of the photoelectric stop motions were reduced so that they would no longer respond to spurious signals, they would often fail to operate when a yarn did break. When this occurred, defective fabrics or other textile materials would be produced.

Because no satisfactory stop motions were available for certain types of textile machines, such as warp knitting machines, it has heretofore been necessary to supervise these machines constantly during operation to detect and correct yarn breaks as they occurred. As will be readily apparent, this greatly increases the cost of the fabrics or other materials produced by said textile machines.

It is an important object of this invention to provide a stop motion which will be free from the foregoing and other disadvantages of the prior stop motions, and which will be especially efficient in operation and simple in construction.

A further object of this invention is the provision of a photoelectric stop motion, which will not respond to spurious signals and will not require frequent readjustment, but which will operate consistently upon breakage of a yarn to give a warning or stop the textile machine to which it is connected.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claims.

In accordance with this invention, there is provided a photoelectric stop motion, comprising two beams of light, two phototubes upon which the beams of light impinge and an amplifier which is responsive to the difference in the signal from the phototubes caused by the variation in the intensity of the light beams when a yarn passes through one of the light beams. In certain textile machines, wherein two warps of yarn are handled, such as two-bar warp knitting machines, one light beam is positioned to pass adjacent to each of the warps. In other textile machines, wherein only a single warp is handled, one light beam is positioned to pass adjacent to said warp, and the other light beam is positioned to pass through a path of equal length at a point spaced from the first light beam. The second light beam may be positioned adjacent the first light beam so that a broken yarn will pass through both light beams in succession. Alternatively, the second light beam may be positioned at a point completely removed from the warp.

Each of the two light beams may originate in a light projector comprising a lamp housing having a lamp mounted therein and provided with a lens to focus the light from said lamp into a beam. It is preferred to employ a widely diverging light beam, so that shifts in the relative position of the light projector and phototube will cause a minimum of variation in the effective intensity of the light impinging on the phototube. The lamp housing is supported by shock-absorbing mounts, which are designed particularly to minimize the transmission of high-frequency mechanical shocks and vibration to the lamp so that at most the lamp will be subjected to low-frequency shocks and vibration. To produce the light beam, it is preferred to employ a lamp of the incandescent type having a heavy tungsten filament possessing a high thermal inertia, such as an automobile headlight lamp so that the light output of the lamp cannot change at a rapid rate with variations in lamp voltage. To assist further in maintaining the light output constant, the lamp is energized by direct current which is filtered to remove any cyclic variations therefrom. Instead of providing a separate light projector and lamp for each light beam, the two light beams may be derived from a single lamp through suitable optical means.

The light projectors are positioned at one side of the warp and deliver a beam of light in the general direction of light receivers, which are positioned at the other side of the warp. The light receivers each comprise a housing having a phototube and a preamplifier tube mounted therein. Like the lamp housing, the light receiver housing is supported by shock-absorbing mounts to minimize the transmission of mechanical shocks and vibration to the phototube and preamplifier tube.

The output signals from the preamplifier tubes are fed into a comparison circuit, wherein electrical surges, line voltage fluctuations and the residue of cyclic variations in the lamp current are balanced out since they affect both phototubes and both lamps in the same way, causing the light output of the lamps to vary simultaneously. Thus,

each light beam acts as a reference for the other and so long as both are fluctuating in the same manner there will be no difference between them. The circuit in which the output signals of the preamplifier tubes are compared is designed so that it always tends toward equilibrium or zero output. As a result, this circuit automatically compensates for any permanent or semi-permanent differences in the output signals from the preamplifier tubes which may be caused by differences in the light output of the lamps or the sensitivity of the phototubes and preamplifier tubes. It is, therefore, unnecessary to employ precisely matched lamps, or preamplifier tubes or to make adjustments to compensate for the unequal variations of the components due to any cause, such as age, for example.

To insure that any broken yarn in a warp does not become entangled with and is not carried along by the remaining yarns in the warp, means are provided to force the broken yarn through the light beam. This means may take the form of a conduit positioned adjacent the warp and provided with a series of apertures through which a stream of air is directed at the warp. The velocity of the stream of air regulates the speed at which the broken yarn moves, controlling the time required for the yarn to pass through the light beam and the length of the signal produced thereby.

The signal resulting when a yarn passes through one of the light beams is differentiated in the comparison circuit creating a negative and a positive pulse. In this way, the passage of a yarn through either light beam is made to create pulses of both polarities which can be handled alike. The pulses are filtered to eliminate therefrom extremely slow and extremely rapid variations which cannot represent a broken yarn. The filtering circuits are designed so as to eliminate any pulses that result from the low-frequency shocks and vibration that may pass to the lamp through the shock mounts supporting the light projector. The pulses are also compared with a reference voltage. If the pulse is larger than this voltage, it passes through the circuit. Otherwise it is completely suppressed. The sensitivity of the stop motion may be adjusted readily by altering the value of this reference voltage. The pulse is then lengthened and amplified in a power amplifier, and the current from said amplifier is employed to give a warning or to cause the textile machine to which the stop motion is connected to stop. When the broken yarn has been repaired, the textile machine may be put back into operation without the necessity for resetting the photoelectric stop motion in any way.

The photoelectric stop motion of this invention produces the best results when two beams of light and two phototubes are employed therein. However, satisfactory results may also be obtained by using a single beam of light and a single phototube and passing the signal from this phototube through the amplifier described herein. While the fluctuations produced by electrical surges, line voltage fluctuations and the residue of any cyclic variations in lamp current will not be balanced out with a single phototube, the tendency of the circuit toward equilibrium or zero output, the filtering and the sensitivity adjustment will eliminate most of these spurious signals and prevent the operation of the photoelectric stop motion in response thereto.

A preferred embodiment of our photoelectric stop motion applied to a two-bar warp knitting machine will now be described in connection with the accompanying drawings in which

Fig. 1 is a side elevational view of the warp knitting machine showing the devices of this invention applied thereto,

Fig. 2 is a view, partly in section, showing the light projector and light receiver arrangement,

Fig. 3 is a circuit diagram of the amplifier circuit, and

Fig. 4 is a circuit diagram of the power supply for the amplifier in Fig. 3.

Like reference numerals indicate like parts throughout the several views of the drawings.

Referring now to the drawings, the reference numeral **11** designates the frame members of a two-bar warp knitting machine on which are supported warp beams **12** and **13** and tension rods **14** and **15** over which warps **16** and **17** are passed on their way to knitting elements indicated generally by reference numeral **18**. These knitting elements, as is well understood in the art, are operated from the cam shaft **19** and knit the warps **16** and **17** into a fabric **21**, which passes over guide rod **22**, under roller **23** and on to take-up roller **24**.

Positioned above the warps **16** and **17** is a conduit **25** having a plurality of apertures **26** therein, from which a stream of air under pressure is directed onto the warps to force any broken yarns downwardly. The air pressure in the conduit **25** is regulated so that the yarns fall at a rate of between about 5 and 100 inches per second, which produces a pulse of between about 0.1 and 0.005 second when the yarn passes through a light beam having an effective diameter of about 0.5 inch.

Light projectors **27** supported by shock-mounts **28** fastened to the frame member **11** are positioned to one side of the warps **16** and **17**. Each light projector **27** comprises a housing **29**, an incandescent lamp **30** mounted therein, a tube **31** extending from said housing and a lens **32** positioned in said tube and acting to focus the light from the lamp **30** into a beam which passes under the warp **16** or **17**. After traversing the warp, the beam of light from the light projector **27** is picked up by a light receiver **33** supported by shock-mounts **34** fastened to the frame member **11**. The light receiver **33** comprises a light-proof housing **35**, a phototube **36** supported therein on shock-mounts **37**, a light admitting tube **38** extending from said housing and a preamplifier tube **39**, which amplifies the signal from the phototube **36**. A mask **41** having an aperture **42** therein is positioned in the light admitting tube **38** to limit the effective diameter of the portion of the light beam viewed by the phototube **36**. An optical system may be provided in the light receiver **33** to focus the light beam onto the phototube **36**. However, a sufficiently strong signal may be obtained without such optical system for most applications.

Referring now to Figs. 3 and 4 of the drawings wherein the circuit of the photoelectric stop motion is shown, the phototubes **36** have their anodes connected to the plates and their cathodes connected to the control grids of preamplifier tubes **39**. The cathodes of the preamplifier tubes **39** are connected to ground through resistors **43** and **44** and potentiometer **45**, and the control grids of said preamplifier tubes are connected to ground through resistors **46**. With these connections, the cathodes of the preamplifier tubes **39** follow the potential variations of the control grids, and the change in relative potential between the cathodes and the control grids is small, even when signals of considerable magnitude occur.

The phototubes **36** and preamplifier tubes **39** are shielded from magnetic and electric fields by magnetic shields **47** and electrostatic shields **48**. These shields may be combined by using a conductive iron or steel housing, but at some sacrifice in shielding efficiency. In addition, each phototube **36** is enclosed in an inner optical and electrical shield **49**, which is insulated from ground and connected to the cathode of the preamplifier tube **39**. Since the potential variations of the cathode of the preamplifier tube **39**, to which the shield **49** is connected, follow the potential variations of the control grid of said preamplifier tube, the potential difference on the capacitor formed between the phototube **36** and its wiring, on one side, and the shield **49**, on the other side, remains substantially constant. As a result, no large charging current for this capacitor need flow to the phototube **36** through the grid circuit wiring of the preamplifier tube **39**. If the inner shield **49** were omitted, as is usually done, or if the inner shield were grounded,

the changes in the grid potential of the preamplifier tube 39 due to a signal from the phototube 36 would require that the capacitor formed between the phototube 36 and its surroundings be charged or discharged to match the grid potential. This would force a charging current to flow through the grid circuit wires of the preamplifier tube 39 and influence the grid of said tube adversely. The effect of this charging current would be to prevent quick response of the preamplifier tube 39 to signals from the phototube 36, reducing the overall sensitivity of the amplifier.

During operation, a positive voltage is applied to the anodes of the phototubes 36 and the plates of the preamplifier tubes 39 from the terminal 51 through the dropping resistor 52. This voltage is divided between the resistor 46 and the phototube 36 in accordance with the intensity of the light striking the phototube at each instant. When a yarn enters the beam of light striking one of the phototubes 36, the light to the phototube decreases, the current through the phototube diminishes and the voltage across the resistor 46 drops, since this voltage is due solely to the current flowing through the phototube. The drop in the voltage across the resistor 46 swings the grid of the preamplifier tube 39 connected thereto negatively, causing the cathode of said preamplifier tube to swing negatively by the same amount. In like manner, the cathode of the preamplifier tube 39 swings positively when the yarn leaves the beam of light striking one of the phototubes 36.

The cathode potentials of the preamplifier tubes 39 are compared in a series circuit comprising a capacitor 53 and primary winding 54 of a transformer 55 having a secondary winding 56, which circuit is connected at one end between the resistors 43 and 44 and at the other end to the tap on the potentiometer 45. By adjusting the potentiometer 45, which acts as a balance control, it is possible to equalize the effects of line voltage fluctuations, electrical surges, vibration, etc. A perfect adjustment of the potentiometer 45 is not necessary, since any permanent unbalance simply results in a steady voltage across the capacitor 53, and does not cause a current to flow through said capacitor and the primary winding 54. However, when a yarn enters the beam of light striking one of the phototubes 36 and causes the cathode of the preamplifier tube 39 connected to said phototube to swing negatively, a signal current flows through the capacitor 53 and the primary winding 54 in one direction until the voltage across said capacitor has been changed by an amount equal to the change in cathode potential. Similarly, when the yarn leaves the light beam causing the cathode of the preamplifier tubes 39 to swing positively, a signal current flows through the capacitor 53 and the primary winding 54 in the other direction until the voltage across said capacitor has again been changed by an amount equal to the change in cathode potential. The capacitor 53 thus acts to differentiate any change in the cathode potential of the preamplifier tubes 39, so that the passage of a yarn through either of the light beams produces a signal current in both directions through the primary winding 54. A similar differentiating effect may be obtained from the transformer 55. As a result, the amplifier need be responsive to a signal of only one type. The magnitude of the current flowing through the primary winding 54 depends upon the rate of change of the difference in potential between the cathodes of the preamplifier tubes 39. Accordingly, when the difference in potential between the cathodes of the preamplifier tubes 39 varies more slowly than a predetermined minimum, representing the signal produced by the passage of a yarn through the light beam at the lowest speed, the current flowing through the primary winding 54 is very small and will not cause operation of the photoelectric stop motion, as will be described more fully hereinafter.

The signal produced by the passage of a yarn through the light beam passes through the transformer 55 to the control grid of an amplifier tube 57, which is biased negative almost to cut off. Because of the high negative bias on the control grid of the amplifier tube 57, negative polarity signals have little effect on the plate current of said tube, but positive polarity signals cause a marked increase in plate current. This increase in plate current causes a negative signal to be applied to the control grid of an amplifier tube 58, which is biased slightly negative so that maximum plate current flows through it normally with no signal. Because of the slight negative bias on control grid of the amplifier tube 58, positive polarity signals have little effect on the plate current of said tube, but negative polarity signals cause a marked decrease in plate current. The polarity and biasing arrangements of the amplifier tubes 57 and 58 make the amplifier selectively responsive to signals of one polarity and greatly decrease the responsiveness of the amplifier to signals of different polarity. Any signals that vary more rapidly than a predetermined maximum, representing the passage of a yarn through the light beam at the highest speed, are bypassed to ground by capacitors 59, 61 and 62, which are connected to the plates of the preamplifier tubes 39 and the amplifier tubes 57 and 58, respectively. As a result, these rapidly varying signals have only a slight effect on the plate current of the amplifier tube 58 and do not cause operation of the photoelectric stop motion, as will be described more fully hereinafter.

The decrease in the plate current of the amplifier tube 58 produced by the passage of a yarn through the light beam causes a positive signal to be applied to the control grid of a clipper tube 63, which is biased beyond the cut-off point so that no current normally flows through its plate circuit. When the amplitude of the positive signal applied to the control grid of clipper tube 63 is sufficiently great, a current flows momentarily through the plate circuit of said tube. However, when the amplitude of the positive signal applied to the control grid of the clipper tube 63 is less than a predetermined minimum, such as results from extremely slow or extremely rapid variations in light intensity, no current flows in the plate circuit of said tube. The amplitude of the positive signal necessary to cause a current to flow in the plate circuit of the clipper tube 63 depends upon the bias voltage applied to said tube and may be controlled by means of a variable resistor 64, which acts as a sensitivity control.

The momentary flow of current in the plate circuit of the clipper tube 63 causes a large increase in the charge on a capacitor 65 which is connected in series with said plate. After the flow of current in the plate circuit of the clipper tube 63 ceases, the capacitor 65 discharges slowly through a resistor 66, connected across its terminals, whose resistance is selected so that it takes approximately 0.3–0.4 second for the capacitor to discharge. During the interval of time for which the capacitor 65 has a charge thereon, there is a negative signal applied to the control grid of an amplifier tube 67, and this causes a corresponding positive signal to be applied to the control grid of a power amplifier tube 68 causing current to flow in the plate circuit of said tube, which circuit includes a relay coil 69 shunted by a capacitor 71. The flow of current through the relay coil 69 operates the contacts 72 to stop the textile machine to which the stop motion is connected or to give a warning that yarn breakage has occurred.

The power supply for the amplifier includes an alternating current power line 73, which is connected to the primary winding 74 of a transformer 75 having secondary windings 76, 77, 78 and 79. The secondary winding 76 is connected to a bridge rectifier 81, which furnishes current to terminals 82 through a variable resistor 83 and a filter, comprising capacitors 84 and 85 and a choke coil 86. From the terminals 82, filtered direct current is supplied to the lamps 39 through terminals 87, and also

to the filaments of the preamplifier tubes 39 through terminals 88. Filtered direct current is used on the filaments of the preamplifier tubes 39 to minimize the ripple which would otherwise be introduced into the amplifier. The filaments of all the other vacuum tubes in the amplifier are supplied with alternating current from the secondary winding 77. The high voltage supply for the amplifier is obtained from the secondary winding 78, which is connected to a full-wave rectifier 89 whose filament is energized from the secondary winding 79. After being rectified, the high voltage is filtered by means of capacitors 91 and 92 and choke coil 93. The filtered, high-voltage is connected to terminals 94, and 96 through dropping resistors 98, 99 and 101. The terminal 94 supplies current to the terminal 51 for the phototubes 36, the preamplifier tubes 39 and the amplifier tubes 57 and 58. The terminal 95 supplies current to a terminal 102 for the clipper tube 63 and amplifier tube 67, and the terminal 96 supplies current to a terminal 103 for the power amplifier tube 68. Voltage stabilizing tubes 104, 105 and 106 are connected across the high voltage supply to assist in maintaining a constant voltage on the amplifier.

While the photoelectric stop motion of this invention is especially useful with warp knitting machines, it is also applicable to other types of textile machines and to various other equipments wherein it is desired to employ variations in the intensity of a light beam for control purposes.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. A photoelectric stop motion, comprising a phototube, means for projecting a beam of light onto said phototube, operatively connected to the phototube an amplifier including means for comparing the signal from the phototube with a reference voltage whereby signals below a predetermined value will not cause operation of the stop motion, and means connected to the amplifier for stopping the operation of a machine when the signals exceed said predetermined value.

2. A photoelectric stop motion, comprising a pair of phototubes, means for projecting a beam of light onto each of said phototubes, operatively connected to the phototubes an amplifier responsive to the difference in the signal from the phototubes when the illumination on one of the phototubes is varied including means for comparing the difference in signals from the phototubes with a reference voltage whereby a difference in signals below a predetermined value will not cause operation of the stop motion, and means connected to the amplifier for stopping the operation of a machine when the signals exceed said predetermined value.

3. A photoelectric stop motion, comprising a phototube, means for projecting a beam of light onto said phototube, and operatively connected to the phototube an amplifier including means for differentiating the signal from the phototube whereby both a negative and a positive pulse are produced when the illumination on the phototube is varied, and means for amplifying pulses of one polarity only.

4. A photoelectric stop motion, comprising a pair of phototubes, means for projecting a beam of light into each of said phototubes, and operatively connected to the phototubes an amplifier responsive to the difference in the signal from the phototubes when the illumination on one of the phototubes is varied, including means for differentiating the difference in signals from the phototubes whereby both a negative and a positive pulse are produced when the illumination on one of the phototubes is varied, and means for amplifying pulses of one polarity only.

5. A photoelectric stop motion, comprising a pair of phototubes, means for simultaneously projecting beams of light of substantially equal intensity onto said phototubes whereby the phototubes will normally emit signals of equal intensity, and, operatively connected to the phototubes, an amplifier responsive to the difference in the signal from the phototubes when the illumination on one of the phototubes is varied, whereby said amplifier will pass a signal when the illumination on one only of the phototubes is varied, said amplifier including filtering means for eliminating signals having a frequency outside a predetermined range.

6. A photoelectric stop motion for a textile machine wherein a warp of yarns is handled, comprising a phototube positioned at one side of said warp, means positioned at the other side of the warp for projecting a beam of light onto the phototube, a second phototube, means for projecting a beam of light onto said second phototube, and operatively connected to the phototubes means responsive to the difference in signals from the phototubes when a warp yarn passes through the light beam.

7. A photoelectric stop motion for a textile machine wherein a warp of yarns is handled, comprising a phototube positioned at one side of the warp, means positioned at the other side of the warp for projecting a beam of light onto the phototube, a second phototube, means for projecting a beam of light having a path equal in length to the length of the first beam of light onto said second phototube, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through the light beam.

8. A photoelectric stop motion for a textile machine wherein a warp of yarns is handled, comprising a phototube positioned at one side of the warp, means positioned at the other side of the warp for projecting a beam of light onto the phototube, means for forcing a broken yarn through the light beam, a second phototube, means for projecting a beam of light having a path equal in length to the length of the first beam of light onto said second phototube, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through the light beam.

9. A photoelectric stop motion for a two-bar warp knitting machine wherein two warps of yarn are knitted into a fabric, comprising a phototube positioned at one side of each of the warps, means positioned at the other side of each of the warps for projecting a beam of light onto each of the phototubes, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through either light beam.

10. A photoelectric stop motion for a two-bar warp knitting machine wherein two warps of yarn are knitted into a fabric, comprising a phototube positioned at one side of each of the warps, means positioned at the other side of each of the warps for projecting a beam of light onto each of the phototubes, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through either light beam including a circuit in which the signals from the phototubes are compared.

11. A photoelectric stop motion for a two-bar warp knitting machine wherein two warps of yarn are knitted into a fabric, comprising a phototube positioned at one side of each of the warps, means positioned at the other side of each of the warps for projecting a beam of light onto each of the phototubes, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through either light beam including a circuit containing a series condenser in which the signals from the phototubes are compared whereby both a negative and a positive pulse are produced when a yarn passes through a light beam.

12. A photoelectric stop motion for a two-bar warp

knitting machine wherein two warps of yarn are knitted into a fabric, comprising a phototube positioned at one side of each of the warps, means positioned at the other side of each of the warps for projecting a beam of light onto each of the phototubes, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through either light beam including a circuit containing a series condenser in which the signals from the photoubes are compared whereby both a negative and a positive pulse are produced when a yarn passes through a light beam, and means including an amplifier tube having a high negative bias and an amplifier tube having a slight negative bias connected in series for selectively amplifying the positive pulse.

13. A photoelectric stop motion for a two-bar warp knitting machine wherein two warps of yarn are knitted into a fabric, comprising a phototube positioned at one side of each of the warps, means positioned at the other side of each of the warps for projecting a beam of light onto each of the phototubes, means positioned adjacent each of the warps for forcing a broken yarn through the light beam, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through either light beam including a circuit containing a series condenser in which the signals from the phototubes are compared whereby both a negative and a positive pulse are produced when a yarn passes through a light beam, and means including an amplifier tube having a high negative bias and an amplifier tube having a slight negative bias connected in series for selectively amplifying the positive pulse.

14. A photoelectric stop motion for a two bar warp knitting machine wherein two warps of yarn are knitted into a fabric, comprising a phototube positioned at one side of each of the warps, means positioned at the other side of each of the warps for projecting a beam of light onto each of the phototubes, means positioned adjacent

each of the warps for forcing a broken yarn through the light beam, and operatively connected to the phototubes an amplifier responsive to the difference in the signals from the phototubes when a warp yarn passes through either light beam including a circuit containing a series condenser in which the signals from the phototubes are compared whereby both a negative and a positive pulse are produced when a yarn passes through a light beam, means including an amplifier tube having a high negative bias and an amplifier tube having a slight negative bias connected in series for selectively amplifying the positive pulse, means for lengthening said positive pulse, and filtering means for eliminating undesired signals.

15. A photoelectric stop motion, comprising a phototube, means for projecting a beam of light onto said phototube, mounts for said light projector including means for minimizing the transmission of high-frequency mechanical shocks and vibration thereto whereby the light projector will be subjected at most to low-frequency shocks and vibration, and operatively connected to the phototube an amplifier including filtering means for eliminating the signals produced by said low-frequency shocks and vibration.

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