May 7, 1940. W. DUBILIER 2,199,396

SYSTEM FOR CONTROLLING KNITTING

Filed Sept. 27, 1934 3 Sheets-Sheet 1

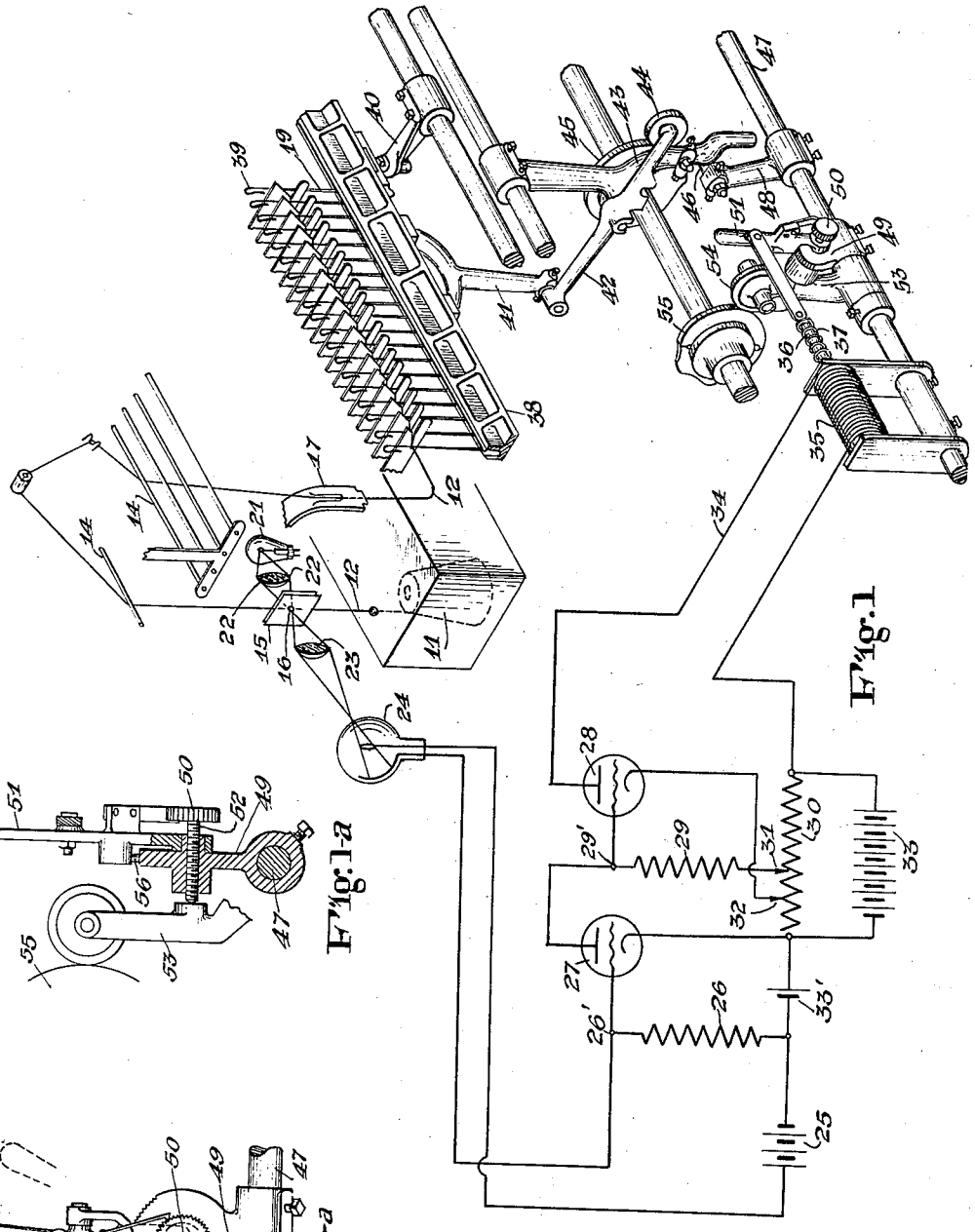


Fig. 1

Fig. 1-a

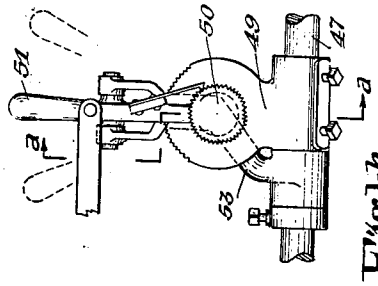


Fig. 1-b

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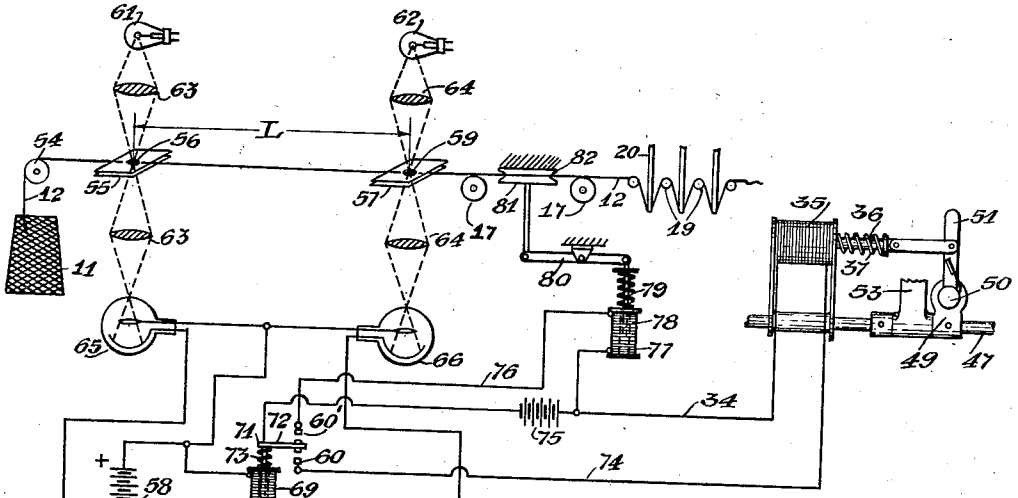


Fig. 2

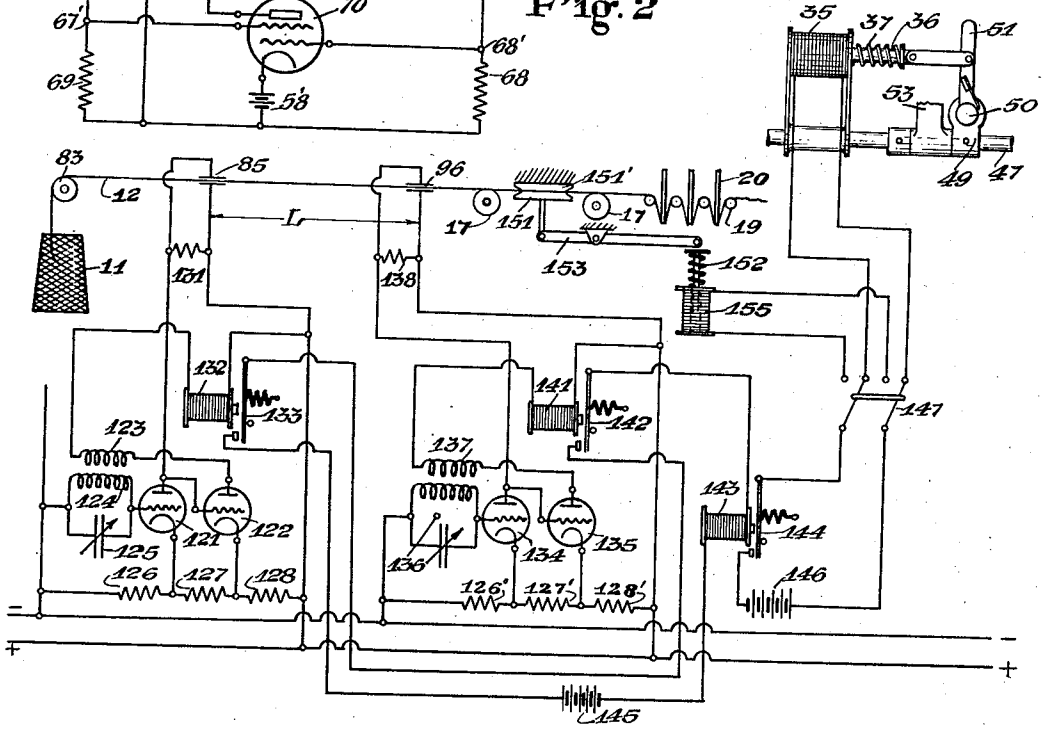


Fig. 3

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SYSTEM FOR CONTROLLING KNITTING

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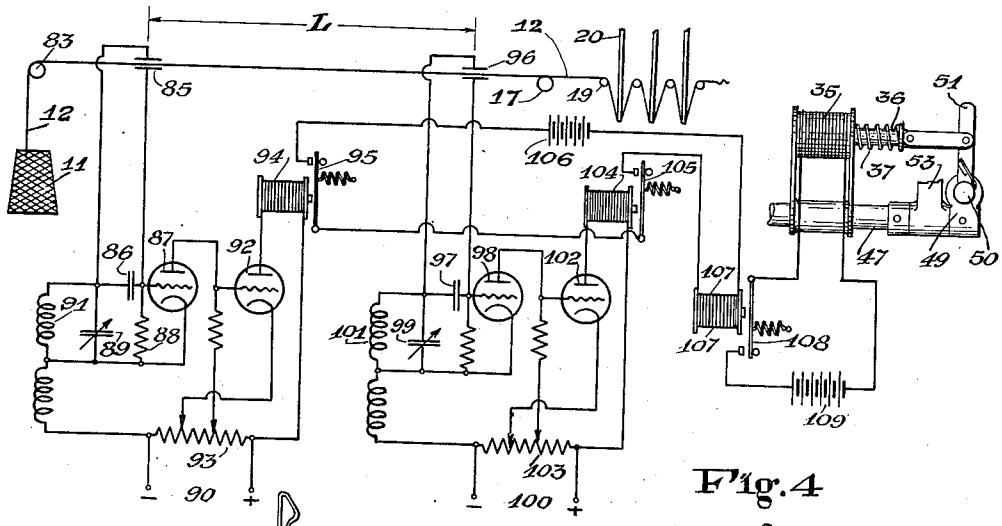


Fig. 4

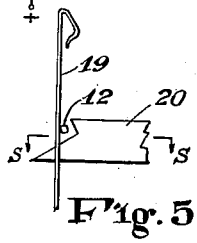


Fig. 5

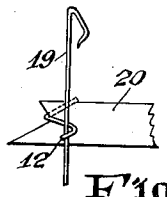


Fig. 6

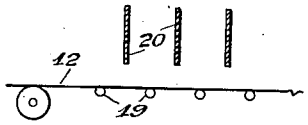


Fig. 7

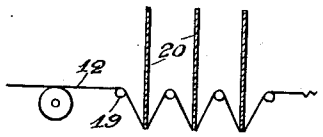


Fig. 8

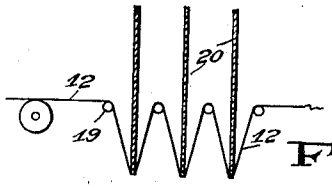


Fig. 9

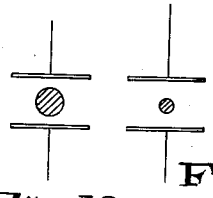


Fig. 10

Fig. 11

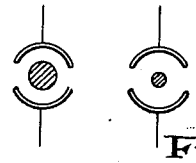


Fig. 12

Fig. 13

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Patented May 7, 1940

2,199,396

UNITED STATES PATENT OFFICE

2,199,396

SYSTEM FOR CONTROLLING KNITTING

William Dubilier, New Rochelle, N. Y.

Application September 27, 1934, Serial No. 745,705

18 Claims. (Cl. 66—82)

My invention relates to novel apparatus for and methods of knitting and more particularly relates to novel apparatus for and methods of providing a mesh of uniform appearance for making silk apparel such as silk stockings.

The natural silk thread used in silk wearing apparel is produced by normally interlacing or rolling together the individual fine threads obtained from the silkworm. A predetermined number of such fine threads are used, depending on the thickness of the final thread to be wound on spools. As the interlacing of the thin threads proceeds, it often happens that there is a variation in the number of individual threads used, resulting in a variation in the thickness of the final thread.

Such slight variations in the thickness of the threads, particularly if the variations extend to any great length, becomes a serious defect in the production of silk apparel of wide mesh, as in the case of sheer stockings. Here the mesh used is relatively wide, so that the silk threads are individually visible. Variations in the thickness of these threads thus become readily noticeable, destroying the much desired aesthetic effect of uniformity in mesh and thickness.

I have discovered that I can detect such variations in the thickness of the thread and automatically compensate therefor to produce a uniform appearance in the mesh.

Accordingly, an object of my invention is to provide novel apparatus for and methods of detecting the variations in thickness of a silk thread.

A further object of my invention is to provide novel apparatus for and methods of manufacturing silk wearing apparel of uniform appearance.

Still a further object of my invention is to provide novel apparatus for and methods of manufacturing silk sheer stockings of uniform appearance.

Another object of my invention is to provide novel apparatus for and methods of automatically compensating for variations of thickness of a thread.

Still another object of my invention is to provide electrical means for measuring, detecting and compensating for variations in thickness of a silk thread.

Still a further object of my invention is to provide novel apparatus for and methods of varying a condenser capacity in accordance with the variations in thickness of a thread and for measuring this capacity.

Still another object of my invention is to provide novel apparatus for and methods of controlling the light impinged on a photoelectric cell in accordance with the variations in the thickness of a silk thread.

There are other objects of my invention which together with the foregoing will appear in the detailed description which is to follow in connection with the drawings in which:

Figure 1 is a circuit diagram and perspective illustrating one embodiment of my invention for measuring the thickness of a silk thread by controlling the light impinged on a photoelectric cell;

Figure 1*a* is a cross section through *a*—*a* of Figure 1*b*;

Figure 1*b* is a detail of the adjusting mechanism of Figure 1;

Figure 2 is a circuit diagram showing a modified form of the invention disclosed in Figure 1;

Figure 3 is a circuit diagram of a modified form of my invention in which a capacity of a condenser is varied in accordance with the thickness of a silk thread;

Figure 4 is a circuit diagram of a further modified form of the circuit shown in Figure 3;

Figures 5 and 6 indicate how the downward excursion of a sinker bar forms a loop in the thread;

Figures 7, 8 and 9 illustrate how the depth of horizontal excursion of the needles affects the length of the loop in the thread; and

Figures 10 to 13 are enlarged cross-sectional views of the method of controlling the condenser capacity.

Referring now more specifically to Figure 1, I have shown, for purposes of illustration, a spool 11 on which is wound a silk thread 12 whose possible variations in thickness are to be measured. The silk thread 12 is carried over the guiding rods 14 and between guiding plates 15, having a slot 16 therein to permit light to pass through there, as will be described hereinafter. The thread 12 is then guided over traveling guide 17 to the knitting machine.

Opposite member 15, a source of light 21 throws a beam of light through the lens 22, focused at slot 16, past thread 12 and through the lens 23. This beam is then impinged on the photoelectric cell 24, the amount of the light impinging on the photoelectric cell 24 at any instant being, as is shown, a function of the thickness of the silk thread passing in front of the beam at that instant. The photoelectric cell 24 of any well-known construction is connected to a source of potential 25 through a series resistance 26. The

variations in the impinging light cause similar variations in the current flowing through the photoelectric cell **24** and the resistance **26**. This varying current causes corresponding variations in the potential of point **26'** which is connected directly to the grid of the tube **27** for amplification.

For purposes of illustration I have shown two tubes, **27** and **28**, directly coupled from anode to grid with suitable potentials applied to the electrodes through the resistances **29** and **30** by means of taps **31** and **32** with a source of B battery **33** connected across resistance **30**, and a biasing battery **33'** for the grid of tube **27**. This arrangement is to provide further amplification of the potential variations corresponding to the light impinging on the photoelectric cell.

It will be understood that any other suitable amplifying circuit may be used for amplifying the potentials generated at the photoelectric cell. Moreover, although a photoelectric cell with an operating battery is disclosed, it will be understood that a voltaic type of cell generating its own energy may be substituted. Although I have disclosed a light arrangement in which the amount of light impinged on a photoelectric cell is varied in accordance with the thickness of a thread by varying the amount of light which passes the thread, I may, if desired, use the reflecting principle in which a beam of light is reflected from the thread, the amount of light thus reflected varying in accordance with the thickness of the thread.

As the amount of light impinging on the photoelectric cell changes with the variations in thickness of the thread, the voltage impressed across the input of the first tube varies correspondingly and the current flowing in the output circuit of the last tube is thus also varied. The output circuit of the last tube is connected by the conductor **34** through an electromagnet **35** which controls the plunger **36**. Plunger **36** (biased by spring **37** to the right end of its travel when no current flows in the electromagnet **35**) controls the adjustment (to be described) for varying the mesh in accordance with the thickness of the thread. It will be understood from the following description that a sufficient time delay is allowed so that the portion of the thread which produced the electrical effect for operating magnet **35** has reached the machine.

The width of the mesh produced depends upon the lengths of the loops and these in turn depend upon the movement of the needles. This variation is obtained as follows:

The needle bar **38**, with needle **39** in place for operation is movable vertically. This motion is imparted to it by lever **40** while the rocking or presser motion is caused by levers **41**, **42** and **43**. Cam lever **43** is provided with roller **44**, which works against presser cam **45**. In the absence of any other means of regulation the outline of cam **45** would determine the length of the loops, as it keeps the needles **39** at a fixed distance from the well known sinkers. A number of levers (not shown) are ordinarily, however, distributed equally over the entire length of the machine, to limit the travel of lever **43** in the direction of the arrowhead. This is done by stud **46**, which arrests the motion of the needle controlling levers in the manner illustrated, thus keeping roller **44** away from cam **45**. It is clear that any change in the position of stud **46** relative to lever **43** will also change the motion of this lever and thus the length of the loops. Such changes in the position of stud **46** are brought about by slight turns of the regulating shaft **47** and its lever **48**. This oscillating motion is imparted to the regulating shaft by a loose course lever, a split slack lever (not shown) and a regulating lever.

The "regulating lever" **49** is provided with a micrometer adjustment **50**, which is used to make fine adjustments in the length of the loops. By means of hand lever **51** a screw **52** (Figure 1*a*) is turned which throws lever **53**, and with it roller **54**, towards or away from cam **55**, as required.

The operation will now be quite obvious. As cam **55** rotates, roller **44** will follow and, depending on the setting of **52**, the motion of the follower **44** will be imparted to regulating shaft **47**, since the parts carrying screw **52** are secured to the shaft **47** by set screws as shown.

Rocking of shaft **47** in turn rocks lever **48** to move pins **46**, which in turn controls the extent to which follower **44** will be allowed to follow cam **45**, and therefore the size of the loops. A plunger **56** working in ratchet teeth holds **47** in any desired position. Thus the length of the loops can be accurately adjusted to suit all requirements.

The operation of the device will now be obvious.

The silk thread is constantly being fed between the source of light and photoelectric cell to the knitting machine. As the thickness of the thread varies, the light passing around the thread and impinged on the photoelectric cell varies correspondingly and in turn varies the voltage impressed on the input of the first tube. As the output from the last tube is thus varied, electromagnet **35** is variably operated and through proper mechanical connections, controls the excursion of the needles and therefore the mesh.

When the thickness of the thread becomes less, a closer mesh is desired. A thinner thread permits a greater amount of light to be impinged on the photocell. More current then flows through photocell **24** and resistance **26**. The potential of point **26'** is proportionately increased, making the grid of tube **27** more positive which thus causes an increased output current flow through resistance **29**. The corresponding drop in potential at point **29'** is transmitted as a decreasing potential to the grid of tube **28**. This increases the anode to cathode resistance of tube **28**, resulting in a smaller current flow in its output circuit. A decreased current flow through electromagnet **35** causes it to correspondingly decrease its attractive force on the plunger **36**. When normal output current is flowing through electromagnet **35**, it is designed to attract the plunger **36** to the center of its operating position. This is the normal position corresponding to the normal thickness of thread. A thinner than normal thread thus causes a decrease in the current output which results in spring **37** pushing plunger **36** towards the left. This action causes the excursion of needle bar **38** to become less as herein described.

It will be obvious that other forms of amplifying circuit may be used or, if desired, I may modulate a local modulator for increasing the detecting action of the silk thread thickness. It will be further obvious that the mechanism herein disclosed is schematic and merely for the purpose of illustrating one application of my invention.

In Figure 2 I have disclosed a modified form of my invention in which the mesh is controlled not only by the thickness of the thread, but by the length of thread over which this variation

in thickness persists. I have discovered that when the variation in thickness exists for only a short length of the thread that this does not noticeably affect the appearance of the knitted article and that variations in thickness become apparent only when the length of the thread over which the variation in thickness occurs extends for a predetermined length. Accordingly the control of the mesh should be effected only if the variation in thickness of the thread occurs for that predetermined length. Such a control is disclosed in Figure 2.

In this figure I have disclosed a modified form of my invention in which the spool 11 carries the silk thread 12 which is guided over the roll 54 between guide plates 55 having a slot 56 therein and thence over the guide plates 57, slotted at 59 similarly to plates 55, to the knitting machine. Sources of light 61 and 62 operating through their lens systems 63 and 64 impinge light on their respective photoelectric cells 65 and 66, the intensity of the light impinged varying in accordance with the thickness of the silk passing by the slots 56 and 59 and obstructing the beam of light.

The photoelectric cells are each connected across the common potential supply 58 through their respective equal series resistances 67 and 68. Variations in the light intensity impinging on these cells cause corresponding variations in the potentials of points 67' and 68', this action being identical to that of point 26' in Figure 1.

A special electron tube 70, having two independent control grids, is used. These grids are directly connected to the points 67' and 68' as indicated in Figure 2. Battery 58' is for properly and equally biasing these grids with respect to the common cathode. Interposed between the anode of the tube 70 and the B potential source 58 is a relay 69 which controls plunger 71. Arm 72, attached to the end of this plunger, projects between the contacts 60 and 60'.

When very little current flows through relay 69 the plunger 71 is held against contact 60' by spring 73. Normal anode circuit current flowing through relay 69 corresponds to the condition when a normal thickness of thread passes through the machine. The relay is designed to attract plunger 71 just enough to position the arm 72 centrally between contacts 60 and 60' when normal current flows. This position of the arm 72 is indicated in Figure 2.

When the light impinging on one photoelectric cell increases, more current flows through the corresponding resistances 67 or 68, raising the potential of point 67' or 68'. The increase in potential of the connected grid tends to decrease the anode to cathode or internal resistance of the tube 70, just as in the case of Figure 1. However, since the potential of the other grid has not been changed, there results a much smaller internal resistance decrease than would occur if this other grid were absent.

When the light impinging on both photoelectric cells increases by a like amount, both grids increase in potential equally. The effect now is similar to that in a single grid tube or triode, namely, that a normal decrease in the internal resistance occurs. The converse readily follows. The operation of tube 70 is thus seen to be most responsive to equal variations impressed upon both its grids.

When the light impinged on one photocell varies from the predetermined amount, the variable effect on the electron tube 70 is not sufficient to operate the relay 69 in the output circuit. When, however, the variation in thickness persists over the distance L between two sources of light and through corresponding slits, then the two photocells simultaneously affect the electron tube 70 to produce variations in the output current flow. The relay 69 will be operated to in turn operate its armature 71 to cause arm 72 to engage contact 60 or 60'.

If a thinner thread persists over the length L, it will pass more light to each of the photoelectric cells, raising the potentials of the grids of tube 70 and increasing the current flow through relay 69. When this increase equals a predetermined amount, arm 72 is attracted until it contacts point 60. The circuit of battery 75 and electromagnet 35 is then completed through lead 74. Cam 38 is released to the left to raise crank 46 to produce a closer mesh as explained in connection with Figure 1. When the thread is no longer thin, contact 60 is broken and electromagnet 36 attracts cam 38 to its normal position.

Conversely, when a thicker than normal thread persists over length L, a predetermined decrease of the current through relay 69 permits its spring 73 to cause arm 72 to contact point 60'. The circuit of electromagnet 77 and battery 75 is then completed through lead 76. When electromagnet 77 is thus energized, it attracts its plunger 78 against the pressure of spring 79 to cause the lever 80 to bring the tension plates 81 and 82 into action. A pressure exerted between the tension plates 81 and 82 is transmitted as a tension to the thread 12 passing between them. This tension will stretch the thicker thread back to normal thickness.

Thus it will be seen that in accordance with this feature of my invention, small variations in the thickness of the thread do not affect my apparatus, but when the variations extend for a distance sufficient to affect the appearance when the thread is woven into a stocking or the like, that is to say, when the length of the variation is sufficient to make it visible within a reasonable distance, my apparatus automatically functions to compensate therefor by varying the weave or the actual thread thickness.

In the above I have disclosed and described an electro-optical system for controlling a relay through an electrical current in accordance with variations in the thickness of the thread.

In an alternative method for carrying out my invention, I provide means for producing electrostatic variations in a condenser in accordance with the variation in thickness of a thread, the electrostatic variation in turn effecting an electrical circuit. As shown in Figure 4, the spool 11 carries a thread 12 which is guided over roll 83 and between the plates of a condenser 85. The condenser 85 is connected across the terminals of a grid condenser 86 connected to the grid of tube 87. Tube 87, which is here shown as a three-electrode tube, is provided with a grid leak resistance 88, connected across a grid and cathode of the tube. A variable condenser and inductance 89 and 91 form a tuned circuit which is part of a regenerative circuit. Tube 87 is coupled, preferably directly, to the amplifier tube 92 and the power for the system is supplied through the potentiometer 93 connected across the terminals of a suitably source of energy at 90.

Although an oscillator and amplifier system is here described somewhat in detail, it will be understood by those skilled in the art that any type of oscillating or amplifying circuit may be

used. Connected in the output circuit of the second tube 92 is a relay 94, controlling armature 95.

A second condenser 96 is connected like the first condenser 85 across the terminals of grid condenser 97 which in turn is connected to the grid electrode of an oscillating system including tube 98, the oscillating circuit comprising the variable condenser 99 and inductance 101. The output of tube 98 is directly coupled to the second tube 102 and the system receives its power from the potentiometer 103 connected across its source of energy at 100. In the output circuit of tube 102 is connected relay 104 which controls armature 105.

It will be noted that armatures 95 and 105 are connected in series and jointly control an energizing circuit for the relay 107. When a predetermined thickness of the thread passes the condenser 85, the capacity of the condenser is such that it impresses a predetermined voltage across the input of tube 87 and a predetermined current flows in the output circuit of tube 92.

For the normal thickness of thread, circuit adjustments are made such that the current flow is insufficient to operate the relay winding 94 connected in its circuit. When a variation in the thickness of the thread occurs, this will vary the capacity of condenser 85 is a manner well understood by those skilled in the art; and inasmuch as the condenser 85 is connected in parallel with condenser 86, the effect will be to vary the rectifying action of the grid capacities to produce a corresponding variation in the direct current output of the tube. This will reveal itself in the form of an increased current flow in the output circuit of tube 92 to an amount sufficient to energize the relay 94 which will thereupon operate its armature to its closed position. This will have no effect at this time. If, however, the variation in the thickness of the thread continues sufficiently long so that the dielectric in the second condenser 96 is varied, that is to say, the variation of thickness occurs over the distance L so that the capacities of the condensers 85 and 96 are simultaneously varied, a variation in the output current of tube 102 will be produced, as described in detail in connection with the first circuit, from a current value insufficient to energize relay 104 to a current sufficient to energize relay 104.

Armatures 95 and 105 will thus be simultaneously operated to closed position to in turn complete an energizing circuit for the winding of relay 107. Relay 107 upon energization by battery 106 will operate its armature 108 to complete an obvious energizing circuit 109 for the electromagnet 35 which, through suitable mechanical connections, controls the excursion of the sinker bars 20 and thus the width of the mesh. When the thickness again returns to its normal value, the above described operations are reversed and the sinker bars are restored to their normal position. The slope or shape of the upper rods 38' of cam 38 may be designed for a change in width of mesh corresponding to the predetermined change in the thickness of the thread.

In a further modified form of my invention shown in Figure 3, an oscillator circuit, consisting of the electron tubes 121 and 122 and a feedback circuit, including the inductance 123 extending from the output of tube 122 and in inductive relation with the inductance 124 of the tuned circuit, including the variable condenser 125, is arranged to oscillate at a predetermined frequency in the manner described in detail in the co-pending application of Erick Ash, Serial No. 375,459, filed July 2, 1929 now Patent Number 1,990,216.

As described in that application, the direct coupled amplifier is operated from a potentiometer comprising the resistances 126, 127 and 128 connected across a source of power, the anodes of the tubes being in substantially multiple relation with each other. The condenser 85, whose capacity is varied in accordance with the thickness of the thread in the manner described in connection with condenser 85 of Figure 4, is connected across the terminals of a resistance 131 and in the output circuit of tube 121. In this circuit connection the variations in capacity of the condenser 85 do not affect the frequency of the oscillations generated by the oscillators since the cell is so placed that it does not affect the constants of the oscillator circuit. With this arrangement, however, a modulation of the oscillator is obtained in accordance with the oscillations of the capacity of the condenser 85, and these modulated signals flow in the output circuit of the second tube 122 and through the winding of relay 132, controlling the armature 133.

As in the case of Figure 4, a similar circuit is provided, including the electron tubes 134 and 135 directly coupled and connected to the oscillator circuit 136 through the inductance 137, connected in the output circuit of tube 135. Condenser 96, connected across the terminals of resistance 138, controls the amplitude of the oscillatory signals flowing in the output circuit of tube 135 and through the winding of relay 141 to control the armature 142. Armatures 133 and 142 are connected in series so that when these armatures are operated by their energized windings, they move to close their respective contacts and complete an energizing circuit 145 through the winding 143 which by its armature 144 controls the energizing circuit 145 to the electromagnet 35 which, as described in connection with other figures, controls the excursion of sinkers 20 for controlling the width of the mesh.

Normally the amplitude of a current flowing in the output circuit of the second tube of each of the oscillators is such, as a result of the capacity of condensers 85 and 96 respectively, that relays 132 and 141 are not energized.

As described in the co-pending Ash application referred to hereinbefore, a change in capacity of these condensers would produce a considerable increase in the amplitude of the oscillating current sufficient to energize the relay in the output circuit. If the change in capacity occurs in both condensers 85 and 96, due to the fact that the variation in the thickness of the thread persists for the length L, then the variation in the output current of both oscillators will be sufficient to energize their corresponding relays 132 and 141 and the energizing circuit will be completed for the relay 143 which in turn will energize electromagnet 35 for controlling the width of the mesh.

In the above I have described arrangements in which the weaving machine is affected in accordance with variations in the thickness of the silk thread. I have discovered that I can similarly eliminate streaks due to variations in thickness of the thread in stockings by varying a tension on the thread. This variation in tension results in a corresponding variation in the thickness of the thread.

In Figure 2 I have illustrated one simple ar-

rangement for carrying this out by utilizing tension plates 81 and 82.

In Figure 3 I use the same arrangement except that it functions in lieu of electromagnet 35 when the switch 147 is thrown in the proper position. This combination shown for controlling the thickness of the thread or of the width of the mesh is merely illustrative, and any number of variations in the principles involved may be devised.

In Figures 10 to 13 I have illustrated various arrangements of condensers that I may use for measuring the capacity of the thread. Thus in Figures 10 and 11 two straight plates are shown with the diameter of the thread considerably magnified to illustrate the dielectric effect. In Figures 12 and 13 I have illustrated condensers in the form of arcs and arranged to permit the thread to pass therebetween. Similarly, other suitable constructions of condensers may be used in carrying out my invention.

It will be understood that I have disclosed a number of different circuits, including straight amplifying circuits or oscillators controlled optically through photoelectric cells or by electrostatic variations of a capacity, but that these illustrations are merely by way of an example, the principle of my invention, namely the control of an electrical circuit in accordance with the variation in the thickness of a thread to in turn compensate therefor in the knitting machine, may be carried out with other types of electrical circuits than that herein disclosed, as will now be obvious to those skilled in the art. Other means than optical or electrostatic may be used for measuring the thickness of the thread and affecting an electrical circuit thereby.

The control by these circuits may be applied to any type of practical knitting or weaving machine as the particular type of machine used is not part of this invention. It would be a simple task for any person skilled in the art to link the plunger 36 of electromagnet 35 to the loop or weave control lever of any such machine, including a circular knitting machine.

For illustrative purposes I have merely schematically indicated a simple arrangement for determining the width of the mesh in a knitting machine by controlling the excursion of the sinker bars. As I have above stated, actuating the proper control lever of any similar mechanism with my circuits would be just as effective.

In an actual machine, I may design for a suitable time lag between the detection of the variation in the thread thickness, and the corresponding operation of the mesh width control mechanism.

It will be obvious from the above that my invention may take many different forms than those above illustrated, and I do not intend to be limited except as set forth in the appended claims.

I claim:

1. The method of maintaining a substantially uniform appearance of a silk stocking which comprises automatically varying the mesh in accordance with the variations in thickness of the threads making up the mesh.

2. The method of operating a knitting machine which comprises automatically varying an electrical circuit in accordance with the variation of the thread being applied to the knitting machine and controlling the operation of the sinkers in accordance with the variations of the electrical circuit.

3. The method of operating a knitting machine which comprises automatically varying the sinkers thereof in accordance with the variations in the thickness of the thread being fed to the machine.

4. The method of operating a knitting machine which comprises automaticaly varying the sinkers thereof in accordance with the variations in the thickness of the thread being fed to the machine when the said variations in the thickness persist over a predetermined length of thread.

5. The method of operating a silk stocking knitting machine which comprises passing the silk thread being fed to the machine between the plates of an electrical condenser to vary its capacity in accordance with the thickness of the thread, controlling an electrical circuit in accordance with the variation in capacity to generate an electrical current, and controlling the excursion of the sinkers in accordance with the electrical currents generated.

6. The method of operating a silk stocking knitting machine which comprises passing the silk thread being fed to the machine between a source of light and a photoelectric cell to generate a variable electron stream in accordance with the thickness of the thread, controlling an electrical circuit in accordance with the variation in electron stream to generate a variable electrical current and controlling the excursion of the sinkers in accordance with the electrical currents generated.

7. In a knitting machine, the combination with yarn feeding and knitting instrumentalities for forming a series of succeeding courses of similarly formed loops of normally uniform size, of a device for measuring variations in the amount of light admitted through a fixed aperture past the feeding yarn, means for varying the size of the loops formed from said feeding yarn, and means controlled by said measuring device for actuating said loop varying means to form larger loops from portions of said feeding yarn admitting a relatively small amount of light, and to form smaller loops from portions of said feeding yarn admitting a relatively large amount of light through said aperture.

8. In combination, a fabric forming machine, means for feeding yarn to said machine, and means including a detector responsive to waves radiated by said yarn for controlling the operation of said means.

9. In combination, a fabric forming machine, means for feeding yarn to said machine, said yarn being composed of lengths of varying characteristics, and means responsive to said characteristics for controlling the operation of said means.

10. In combination, a knitting machine, means for feeding yarn to said machine, and means including a detector responsive to waves radiated by said yarn for varying the operation of said means.

11. In combination, a knitting machine, means for feeding yarn to said machine, a photoelectric cell responsive to light radiated by the yarn, and means controlled by said cell for varying the operation of said means.

12. In combination, a knitting machine, means for feeding yarn to said machine, said yarn being composed of lengths of varying characteristics, and means at a point between the yarn supply and the needles of the machine and responsive to

said characteristics for varying the operation of said means.

13. In combination, a fabric forming machine, means for feeding yarn to said machine, said yarn having lengths of different dielectric quality, means for varying the operation of the yarn feeding means, and a capacitance of which said yarn forms part for controlling said last mentioned means.

14. In combination, a knitting machine, means for feeding yarn to said machine at a predetermined rate, said yarn having lengths of different dielectric quality, means for varying the operation of the yarn feeding means, a pair of condenser plates between which said yarn passes, and a tuned circuit comprising an electronic discharge device controlled by said condenser plates controlling said means for varying.

15. In combination, a knitting machine, means for feeding yarn to said machine at a predetermined rate, said yarn having lengths of different dielectric quality, means for varying the operation of the yarn feeding means, and a pair of condenser plates between which said yarn passes for controlling said means for varying.

16. In combination, a knitting machine, means for feeding yarn to said machine at a predetermined rate, said yarn having lengths of different dielectric quality, means for varying the operation of the yarn feeding means, and a capacitance of which said yarn forms part for controlling said means for varying.

17. In combination, a knitting machine comprising means for feeding yarn thereto, means controlled by the machine for varying in a predetermined manner the length of yarn fed to the machine during each course, means responsive to characteristics of successive lengths of said yarn, and means controlled by said last mentioned means for regulating the operation of said means for feeding.

18. In combination, a knitting machine, means responsive to characteristics of successive lengths of the yarn, means for feeding yarn to said machine past said means, means for varying the length of the yarn between said means responsive and said knitting machine, means controlled by said first mentioned means for controlling the feeding of yarn to said machine, and means controlled by said machine for actuating said means for varying the length.

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