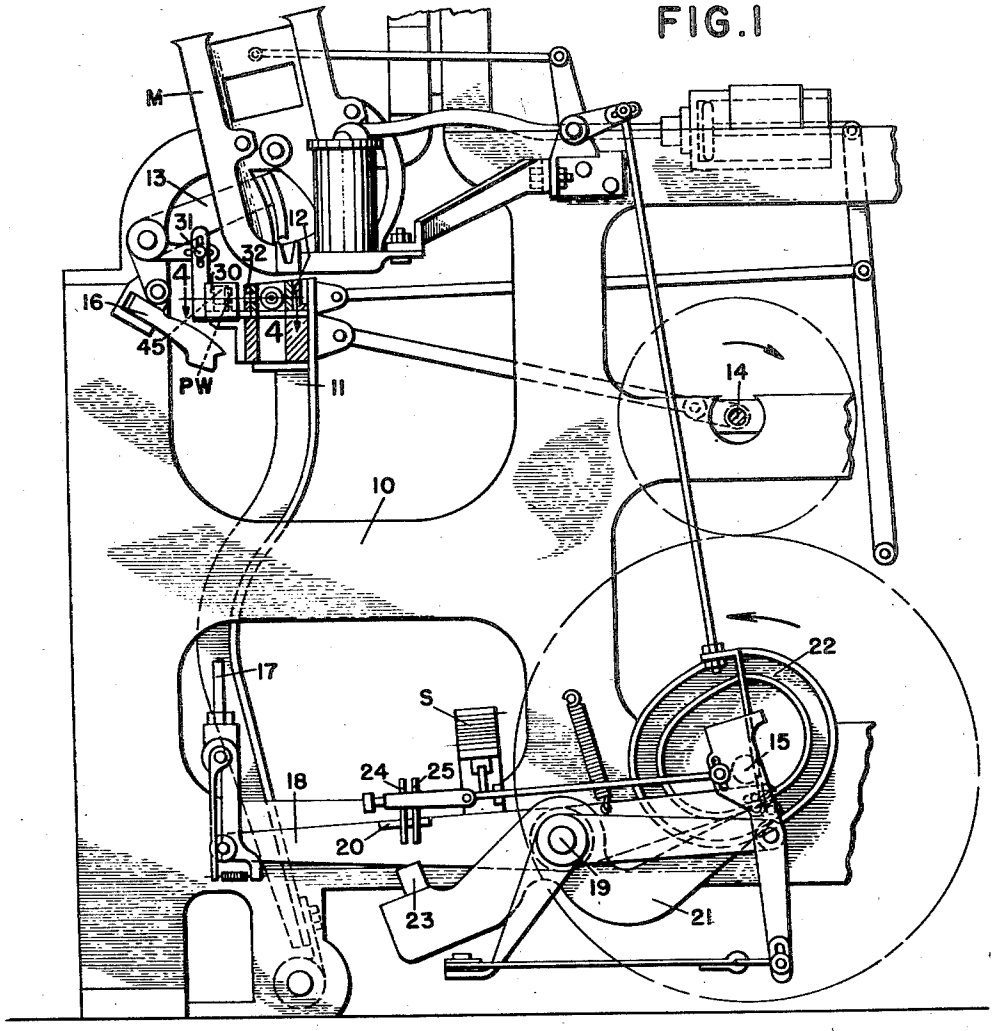
Sept. 12, 1950 R. F. DION ET AL 2,522,101

PHOTOELECTRIC WEFT DETECTOR FOR LOOMS

Filed April 29, 1948 3 Sheets-Sheet 1

FIG.1



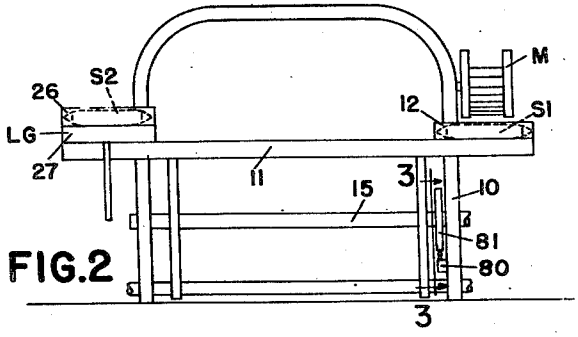
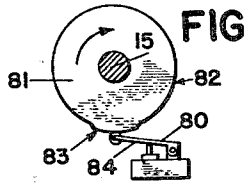


FIG.2

FIG.3



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PHOTOELECTRIC WEFT DETECTOR FOR LOOMS

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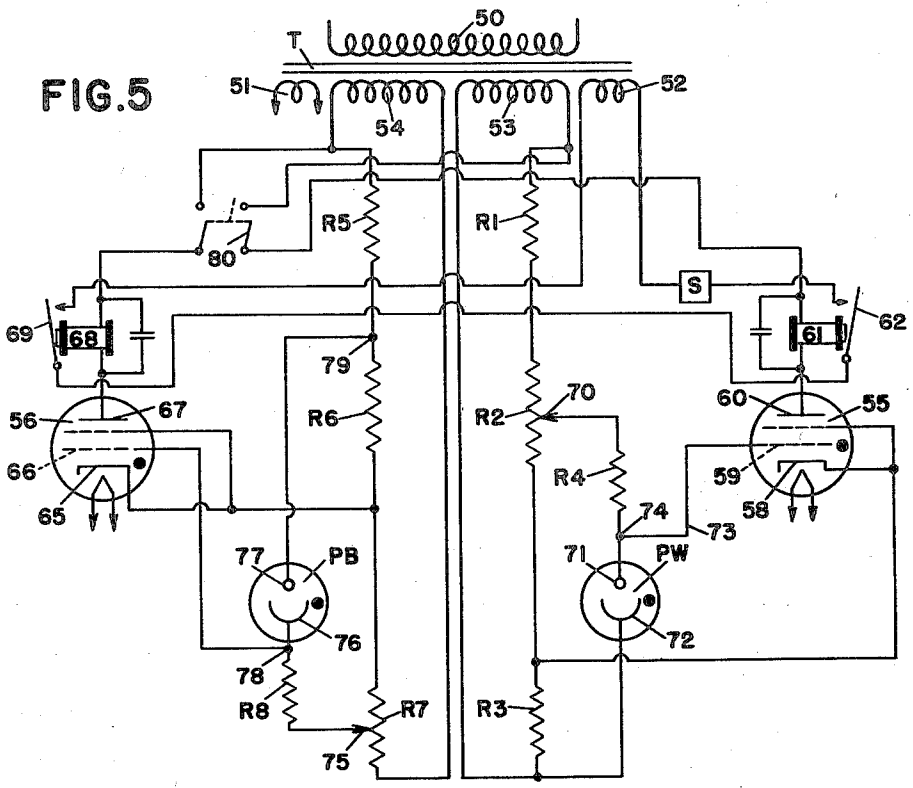
FIG.5



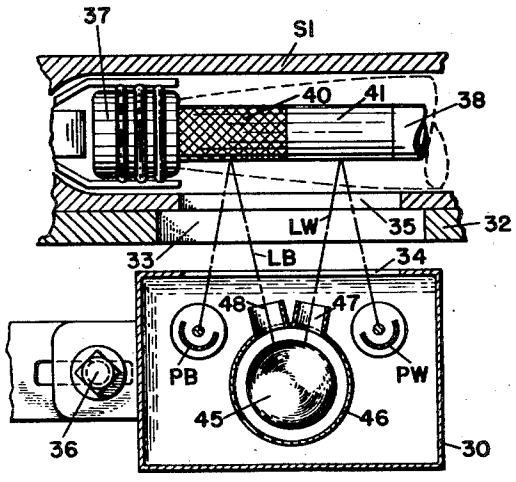


FIG.4

FIG.6

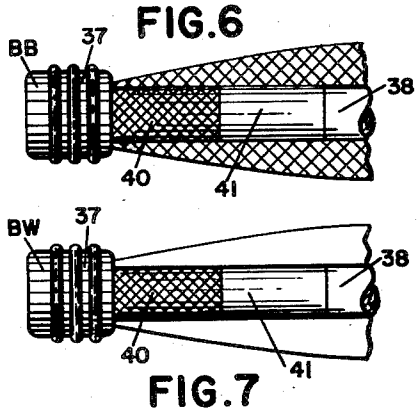


FIG.7

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PHOTOELECTRIC WEFT DETECTOR FOR LOOMS

Filed April 29, 1948 3 Sheets-Sheet 3

FIG.9

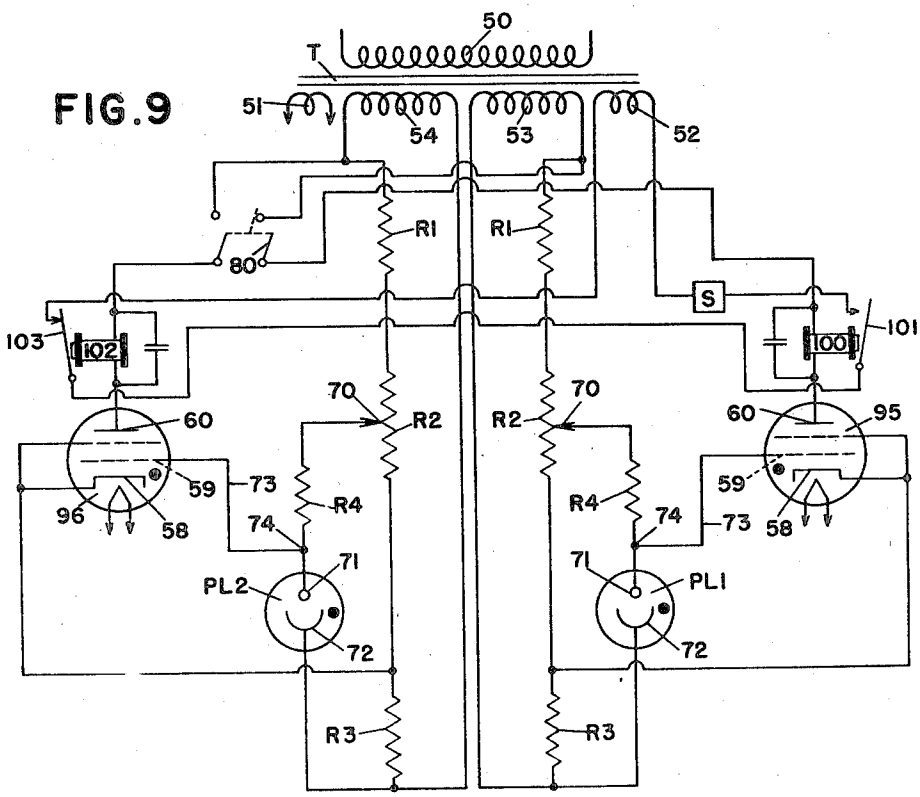


FIG.10

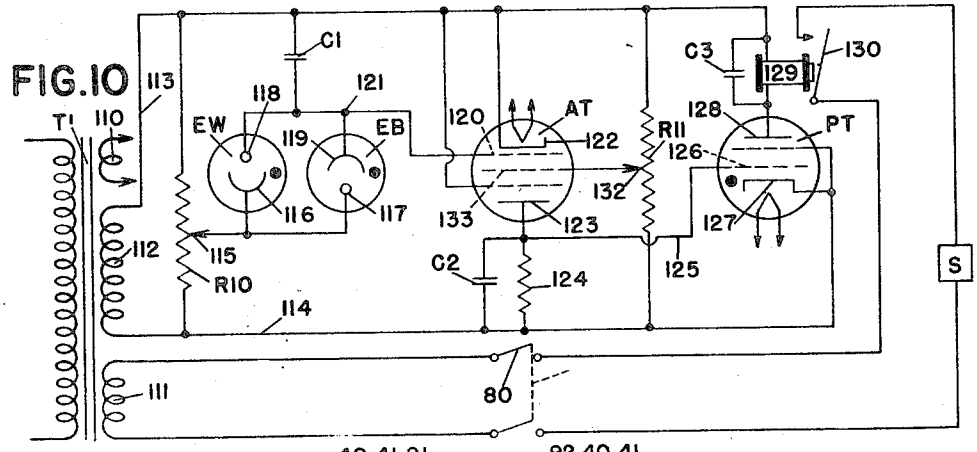
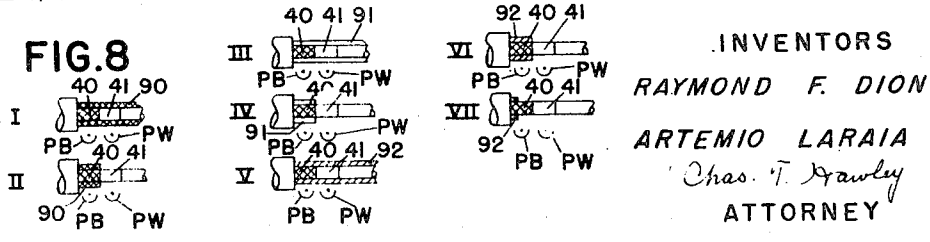


FIG.8



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2,522,101

UNITED STATES PATENT OFFICE

2,522,101

PHOTOELECTRIC WEFT DETECTOR FOR LOOMS

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Application April 29, 1948, Serial No. 23,948

23 Claims. (Cl. 139—273)

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This invention relates to improvements in weft detecting systems for looms and it is the general object of the invention to provide a simple and inexpensive photoelectric weft detecting system usable with all colors and shades of weft.

Heretofore it has been proposed to use a photoelectric cell or eye in a weft detecting system for a loom, but so far as we are aware it has been necessary to employ expensive and highly sensitive equipment to make the detector capable of distinguishing between the light reflected from a surface on the bobbin and that reflected from weft of almost the same color as the surface. Thus, it has been proposed to provide the weft carrying bobbins with a highly polished metallic ferrule to reflect light from a source of illumination to the photoelectric eye when weft is exhausted. When white weft such as rayon is used there is very little difference between the light reflected by it and that reflected from the metallic ferrule. If a dull black bobbin is used it will be difficult to distinguish between it and a dull black weft.

It is an important object of our present invention to provide a photoelectric weft detecting system which will depend for its operation upon two sharply differing degrees or intensities of reflected light when the weft is depleted. Our system employs two photoelectric cells and relatively inexpensive associated equipment such as relays and power electronic tubes.

As set forth hereinafter we provide the bobbins with dark and light colored zones both of which will be covered when there is an ample supply of weft, but both of which will be uncovered when weft is depleted. One of the photoelectric cells will be controlled by the white zone and the other by the dark zone. In this way highly reflective white weft and dull black weft can both be satisfactorily detected.

The detector system is so made that it is usable with any of the usual yarns which may be of any color or any shade. Any given yarn will have the same effect on both photoelectric cells and this similarity of effect can be utilized to maintain a loom controlling circuit inactive so long as ample weft is on the bobbin without regard to the amount of light which the weft reflects. At the time of weft depletion there will be a pronounced change in the amount of light previously reflected from the weft and that reflected from one or the other of the two aforesaid zones on the bobbin.

A weft detecting system of this type is of particular value in a box loom which may operate

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with two or more weaving shuttles. In such a loom one shuttle may carry white weft and the other black weft, and the detecting system should be equally effective in detecting both kinds of weft. Although the invention is of particular use in such a loom its use is not limited to such looms, inasmuch as a one shuttle loom may operate with black weft at one time and white weft at another time. Under these conditions the detecting system set forth herein will be usable without change with any color of weft.

With these and other objects in view which will appear as the description proceeds, our invention resides in the combination and arrangement of parts hereinafter described and set forth hereinafter.

In the accompanying drawings, wherein three forms of our invention are shown:

Fig. 1 is a side elevation partly in section of a multishuttle weft replenishing loom having the preferred form of our invention applied thereto,

Fig. 2 is a diagrammatic front elevation of the loom shown in Fig. 1 showing two weaving shuttles,

Fig. 3 is a detailed enlarged vertical section on line 3—3, Fig. 2, showing a cam and the timing switch for the loom controlling circuit,

Fig. 4 is an enlarged horizontal section on line 4—4 of Fig. 1 showing the bobbin depleted of weft in full lines and indicating an ample supply of weft in dotted lines,

Fig. 5 is a diagrammatic view of the electric circuits used with the preferred form of the invention,

Figs. 6 and 7 are detailed views of two bobbins one of which is wound with dark weft and the other of which is wound with light weft,

Fig. 8 illustrates diagrammatically a series of conditions which can exist on detecting beats of the loom for various arrangements of different wefts,

Fig. 9 is a view similar to Fig. 5 but shows the electric circuit for the first modified form of the invention, and

Fig. 10 is a view similar to Fig. 5 but shows the electric circuit for the second modified form of the invention.

Referring particularly to Fig. 1 which shows one kind of loom on which the invention can be used, the loom frame 10, lay 11, shuttle box 12, two stack reserve bobbin magazine M, the transfer mechanism 13, and the top and bottom shafts 14 and 15 may be of usual construction. The bottom shaft is on two pick time while the top shaft rotates once for every pick of the loom.

The transfer mechanism includes a latch 16 which is normally down but is raised to transfer position to effect a bobbin transfer when a rod 17 is raised from its normal low position. This rod is connected to the forward end of a setting lever 18 pivoted on a fixed stud 19 and having a lifting lug 20. A second or actuating lever 21 also rockable on stud 19 is oscillated by a cam 22 secured to the bottom shaft 15. This second lever carries at its forward end a lifting dog 23 which normally clears the lug 20 but at the time of a weft replenishing operation the dog is moved into lifting relation with respect to the lug by one or the other of two indicators 24 or 25 to effect upward movement of the rod 17 and setting of the loom for a replenishing operation. The fingers 24 and 25 are controlled one at a time by a solenoid S which is normally deenergized, but is energized when weft exhaustion is indicated to move one or the other of the fingers from a normal inactive position to transfer or dog controlling position.

The loom, as shown in Fig. 2, may have shifting shuttle boxes, such as a gang LG, at the left side of the loom having upper and lower boxes or box cells 26 and 27. The loom also has weaving shuttles S1 and S2 which are provided with different wefts and are alternately active and are each replenishable by reserve bobbins of the corresponding colors drawn from the stacks of the magazine M.

The matter thus far described is of common construction in a well-known loom for the weaving of fine wefts and of itself forms no part of our present invention. For further information relative to the loom reference may be had to Patent No. 2,128,974.

As shown in Figs. 1 and 4 a box or the like 30 is mounted as at 31 for vertical and back and forth adjustment relatively to the lay and shuttle box 12. The latter includes in its construction a shuttle binder 32 having an elongated slot 33 similar to that customarily provided for reception of the ordinary mechanical or electrical weft detector. A window 34 in the rear of box 30 is in vertical alignment with binder slot 33 and a slot 35 in the front wall of the shuttle. Box 30 is adjustable as at 36 in a direction lengthwise of the lay.

It is to be understood that the shuttles S1 and S2 are picked according to a sequence determined by the pattern chain not shown and that shuttle S1 will be at the magazine end as shown in Fig. 2 when the lay is on front center position, on certain detecting beats of the loom, while shuttle S2 will be similarly placed on other detecting beats. Ordinarily a shuttle will be at the right end of the loom under the magazine M only on alternate beats of the loom, but the invention is not necessarily limited in its use to a loom operating in this manner.

Referring to Figs. 6 and 7 the two bobbins BB and BW are considered to be wound respectively with black and white filling or weft. Each bobbin will have a butt 37 and a barrel 38. Each barrel is provided with two detecting zones having sharply different capacities for reflecting light. As shown herein a dark zone 40, which may be black, is adjacent to the butt, whereas the other zone 41, which may be of light color or white, is next to the dark zone. The bobbins of the two shuttles, and also the reserve bobbins in the magazine, will all have barrels more or less similar to those described in connection with Figs. 6 and 7.

While the two zones have been specifically described as being black and white, we are not necessarily limited to such a sharp distinction of color, and we may in effect rely upon the natural color of the wood or paper tube of the bobbin for one of the colors or zones and apply the other color or zone either by a dipping operation or a metal ferrule. It is sufficient for the purposes of the present invention if the bobbins are each provided with two zones having markedly different abilities to reflect light.

The box 30 contains a source of light, such as an electric lamp 45, located within an opaque cylinder 46 having two light outlets 47 and 48 preferably of tubular form which permit two beams of light LW and LB to be projected rearwardly through window 34 toward the zones 41 and 40, respectively. As shown in Fig. 4 a light responsive element or photoelectric cell PW is located at the right of cylinder 46 to receive light reflected from the white zone 41, while a second light responsive element or photoelectric cell PB is at the left of cylinder 46 to receive light reflected from the dark or black zone 40. The cylinder 46 and the tubular outlets 47 and 48 shield the photoelectric cells from light emanating from the lamp 45, and the only way that light can reach the photoelectric cells is by reflection.

At each detecting beat of the loom, a shuttle, such as shuttle S1 shown in Fig. 4, will be moved forwardly toward the box 30 and the two light beams will shine rearwardly against the bobbin and then be reflected forwardly toward their respective photoelectric cells. So long as ample weft for continued weaving is present the intensity of the reflected beams of light will be substantially equal so that both photoelectric cells will experience the same degree of excitation, but when the weft is depleted both of the zones 40 and 41 will be uncovered, and under this condition cell PW will receive a relatively strong beam of reflected light while cell PB will receive little or no light. This is the condition under which indication of weft exhaustion will be given to bring about a change in loom operation, such as replenishment of the depleted shuttle, or loom stoppage.

The electric circuits utilized in the preferred form of the invention, shown in Fig. 5 are preferably energized by a transformer T having a primary 50 and four secondary coils. One of these coils 51 supplies low voltage current for the filaments of the electronic power tubes to be described, while another coil 52 may supply a somewhat higher voltage but still relatively low for operation of a loom controlling circuit containing solenoid S. Coil 51 may also supply power for the lamp 45 if desired.

Between the coils 51 and 52 are two equal relatively high voltage secondary coils 53 and 54 arranged at the right and left, respectively, of the upper part of Fig. 5. The electronic tubes are preferably of the gas filled power type and can transmit sufficient current for the energization of a relay. These tubes are indicated at 55 and 56 and correspond, respectively, to the white and dark zones 41 and 40. Tube 55 has a cathode 58 a control grid 59, and a plate 60 connected to a relay 61. The latter controls a switch 62 which will be normally open but will close when tube 55 fires as a result of an increase in illumination of photoelectric cell PW.

Tube 56 has a cathode 65, a control grid 66, and a plate 67 connected to a second relay 68

controlling a switch 69. The latter switch will normally be open but will be closed when the associated photoelectric cell PB is subjected to a decrease of illumination and fires tube 56.

The electronic circuits in Fig. 5 are of different forms to allow one photoelectric cell to operate on an increase of illumination and the other cell to operate on decreased illumination. Three resistances R1, R2 and R3 are in series and connected across coil 53. A variable tap 70 is slidable along resistance R2 and is connected to a resistance R4 which in turn is connected to the anode 71 of photoelectric tube PW. The cathode 72 of tube PW is connected with the left side of coil 53 as indicated in Fig. 5. A wire 73 connects grid 59 of tube 55 to a junction 74 between resistance R4 and the anode 71.

Under insufficient illumination photoelectric cell PW will be idle or inactivated and the grid 59 will be maintained at a potential which will prevent firing of the tube 55, and switch 62 will remain open. Upon a substantial increase in illumination of the tube PW, however, the electric potential of the junction 74 will be raised and the grid 59 will permit current to flow through tube 55 to energize relay 61 and close switch 62.

The other photoelectric circuit at the left of Fig. 5 has three resistances R5, R6 and R7 connected in series across secondary coil 54, and a variable tap 75 for resistance R7 is connected to one side of a resistance R8 the other side of which is connected through junction 78 to the cathode 76 of tube PB. The anode 77 of tube PB is connected to a junction 79 between resistances R5 and R6, and junction 78 is connected to the control grid 66 of tube 56.

When tube PB is illuminated it will maintain grid 66 at an electric level which prevents flow of electrons through tube 56, and switch 69 will remain open, but upon a decrease of illumination the potential of grid 66 will be raised to a level which will permit current to flow through tube 56, and switch 69 will be closed. The circuits for the two tubes PW and PB and their corresponding electronic power tubes are preferably isolated and preferably out of phase by 180°.

In addition to the electronic circuits there is a loom controlling circuit which includes the solenoid S, the secondary coil 52, and the two switches 62 and 69 in series. This loom circuit includes also a normally open switch 80, which is periodically closed during the detecting period by a cam 81 on the bottom shaft. This cam has a relatively long low dwell 82 and a short high dwell 83. The switch 80 includes an arm 84 which is depressed briefly by high dwell 83 to close the switch when the lay is near its front center position on alternate, or detecting beats of the loom. If at this time both of the switches 62 and 69 are also closed solenoid S will be energized and the loom will be set for a change of operation. During the greater part of the cycle of the loom, however, low dwell 82 permits switch 80 to be open so that indication of weft exhaustion can be given only when the parts are substantially as shown in Fig. 4 with the photocells shielded from practically all light except that reflected from the bobbin.

Fig. 8 illustrates several conditions under which the detecting system may operate. In condition I it is assumed that the bobbin is in detecting position and is wound with black weft 90 present in ample amount to cover both detecting zones 40 and 41. Under this condition the surface being detected will cause cell PB to be under decreased illumination and switch 69 will close, but cell PW will also be under decreased illumination and relay 61 will remain deenergized and switch 62 will remain open, since cell PW requires an increase in illumination to close its corresponding relay switch. The solenoid S will therefore remain deenergized.

In condition II it is assumed that the black weft 90 is almost depleted and zone 41 is uncovered. This subjects cell PW to an increase in illumination with resultant closure of switch 62, and since switch 69 is closed as in condition I, closure of switch 80 will close the loom controlling circuit to energize solenoid S.

In condition III it is assumed that an ample supply of white weft 91 is present and covers both zones of the bobbin. Cell PW, being subjected to an increase in illumination due to the white weft, will effect closure of switch 62, but cell PB will also be subjected to an increase of illumination and will not be able to effect closure of its switch 69, hence the loom controlling circuit will remain open.

In condition IV the white weft 91 is almost depleted, but is present in sufficient amount to prevent the decrease of illumination of cell PB necessary for its operation, and switch 69 will remain open. As soon as the weft 91 uncovers enough of the dark or black zone 40 to effect a decrease in illumination of cell PB switch 69 will be closed and solenoid S will be energized.

In condition V it is assumed that a colored weft 92 is present in sufficient amount to cover both zones of the bobbin. Weft 92 may be any desired substantially uniform color, assumed here to be brown. When this brown weft is presented to the photoelectric cells it will have the same effect on both of them, but since the cells require for their operation that one of them have an increase of illumination and the other a decrease, the colored weft can favor or activate only one of the cells while leaving the other cell inactivated. One or the other of the switches 62 or 69 will therefore be open during the detecting interval and the loom controlling circuit will not be closed.

In condition VI it is assumed that the colored yarn 92 is almost depleted and has uncovered zone 41. If in condition V the color had been such as to cause a sufficient decrease of illumination of cell PB to close switch 69 then in this condition VI the increase of illumination of cell PW will effect closure of switch 62 and the loom controlling circuit will be closed. If in condition V weft 92 causes an increase in the illumination of cell PW sufficiently to cause switch 62 to close, then cell PB will be sujected to too much illumination and switch 69 will remain open. After a further depletion of weft 92 sufficient to uncover part or most of zone 40, as in condition VII, cell PB will be subjected to a sufficient decrease of illumination to close switch 69, and the loom circuit will be closed.

As already mentioned, the preferred form of the invention set forth in Fig. 5 employs two different photoelectric units or circuits. In the first modified form of the invention we use two identical units each responsive to an increase in illumination of the corresponding photoelectric cell, but alter the switches which are controlled by the relays.

Referring to Fig. 9, the photoelectric cells PL1 and PL2 are both activated by an increase in the light falling on them. The power tubes 95 and 96 are similar to tubes 55 and 56 described for the

preferred form of the invention. A relay 100 corresponding to relay 61 controls a normally open switch 101 which will be closed when electric current can flow through tube 95. Another relay 102 similar to relay 68 has a normally closed switch 103 which will be opened when electric current can flow through power tube 96. The two photoelectric tube circuits shown in Fig. 9 may be the same as the photoelectric circuit shown at the right of Fig. 5 for tube PW. Each photoelectric cell PL1 and PL2 will be activated by an increase in illumination and will energize its corresponding relay when a relatively strong light beam falls on it, and will remain inactivated when illuminated by a weak light beam.

Referring again to Fig 8 and having in mind the modified circuit of Fig. 9, both photoelectric cells PL1 and PL2 will be inactivated for condition I. Hence switch 101, which is normally open, will remain open. As soon, however, as the weft has been depleted as in condition II, cell PL1 will be activated and switch 101 will be closed, and since switch 103 is normally closed and will remain closed because of the black weft 90 over zone 40, the loom controlling circuit will be closed when the switch 80 is closed.

When white weft is present as in condition III, Fig. 8, photoelectric cell PL2 will effect opening of normally closed switch 103 so that closure of switch 101 due to the presence of white weft 91 will leave the loom controlling circuit open during the detecting interval. This will also be true of condition IV, but as weft 91 uncovers zone 40 relay 102 will be deenergized and switch 103 will be closed during the detecting period to energize solenoid S.

Under condition V the modified circuit will operate in such manner that one or the other of switches 101 or 103 will be open during the detecting interval. If for instance the colored yarn 92 is sufficiently light to cause cell PL1 to effect closure of switch 101, energization of relay 102 will also occur with resultant opening of switch 103 and the loom controlling circuit will be open when switch 80 is closed. On the other hand, if the colored yarn 92 should be so dark that switch 103 cannot be opened, then cell PL1 will receive too little light to effect closure of switch 101.

It will thus be seen that in this first modified form of the invention the same conditions with respect to light and dark zones for variously colored yarns exist as in the preferred form, the difference being that both photoelectric cells require a relatively high degree of illumination to effect operation of their corresponding relays, and the relays control switches one of which is normally closed and the other of which is normally open.

In the second modification of the invention the circuit for which is illustrated in Fig. 10 we employ one relay with its switch normally open and one electronic power tube. Two photoelectric cells are used, one operating on a decrease of light and the other on an increase of light, and in order to insure certainty of operation we use a single stage of amplification.

Referring to Fig. 10, the transformer T' has a low voltage secondary winding 110 for the filaments of the amplifying and power tubes, and has also a second winding 111 for the loom controlling circuit. A third relatively high voltage winding 112 supplies power for the detecting circuits and is connected to wires 113 and 114. A relatively high resistance R10, such as one megohm, is connected across the wires 113 and 114 and has a sliding tap 115 connected to the cathode 116 of the photoelectric cell EW responding to an increase in light and to the anode 117 of the other photoelectric cell EB responding to a decrease in illumination. A very small condenser C1 connects the anode 118 of tube EW and the cathode 119 of tube EB to wire 113.

An amplifying tube AT has a control grid 120 connected to a junction 121 as indicated in Fig. 10. The cathode 122 of tube AT is connected to wire 113 and the plate 123 is connected by a plate resistance 124 to wire 114.

A wire 125 connects the plate 123 to the control grid 126 of a gas filled electronic power tube PT the cathode 127 of which is connected to wire 114 and the plate 128 of which is connected through a relay 129 to wire 113.

The relay 129 has a normally open switch 130 in a loom controlling circuit powered by winding 111 and including the solenoid S. The loom circuit will normally be open whenever relay 129 is deenergized during the detecting period, and it may also include the switch 80 already described in connection with the other forms of the invention.

This second modified form of the invention operates much in the same way as does the first or preferred form in that an increase in illumination of cell EW with respect to cell EB will cause energization of relay 129, and a decrease of illumination of cell EB with respect to cell EW will also energize the relay. When ample weft is being detected both cells are subjected to the same amount of reflected light, and there will be no substantial change in the control grid 120. The loom controlling circuit will therefore remain open whether the weft being detected is dark or light or of any substantially uniform color. It will be noted that only a single relay and only a single electronic power tube is used. A condenser C2, which may be somewhat larger than condenser C1, is in parallel with plate resistance 124, and a sliding tap 132 for a resistance R11 connected across wires 113 and 114 is connected to the screen grid 133 of tube AT. A condenser C3 is in parallel with relay 129 and will be changed whenever tube PT fires and discharges through relay 129 to keep it energized for a brief interval after tube PT ceases to fire.

From the foregoing it will be seen that we have provided a simple and inexpensive weft detecting system by which two light beams of different intensities or strengths can be utilized simultaneously to operate a loom weft detecting system. When weft exhaustion occurs there is a sharp difference in the amounts of light reflected from the two zones of the depleted bobbin, and this sharp difference is utilized to control inexpensive electronic circuit means. The weak and strong beams of light obviate the need for sensitive equipment heretofore needed to enable a single beam to distinguish between a single reflecting surface and a weft of nearly the same color as the surface. The invention is useful in drop box looms operating with two or more weaving shuttles one of which may carry highly reflective white yarn and another of which may carry a dull black yarn, but the invention is not necessarily limited in its use to drop box looms, since it may be used in a single shuttle loom which at one time operates with light colored weft and at another time with dark weft. The loom controlling circuits in the first and second forms of the invention have two switches in series, both of

which must be closed in order to effect indication of weft exhaustion. When ample weft of any color or shade is being detected both photoelectric eyes will receive substantially the same amount of light, but the circuits are such that under this condition, whether the amount of light reflected be strong or weak, closure of the loom controlling circuit is prevented. In the second modification a single relay and power tube unit is used. Furthermore, the bobbin has two detecting zones one of which is capable of reflecting considerably more light than the other, one zone being bright and the other dark so different amounts or degrees of light can be reflected by them.

Having thus described our invention it will be seen that changes and modifications may be made therein by those skilled in the art without dedeparting from the spirit and scope of the invention and we do not wish to be limited to the details herein disclosed, but what we claim is:

1. A loom weft detector system including a source of light and two photoelectric cells and rendered operative to indicate weft exhaustion by simultaneous differential illumination of said cells by beams of light of different intensities derived from said source when weft being detected approaches exhaustion.

2. A weft detecting system including a source of light and two photoelectric cells and dependent for operation thereof upon simultaneous reception by said cells of beams of light of different intensities derived from said source, and means effective upon exhaustion of weft causing said cells to receive said beams of different intensities simultaneously.

3. In a loom having a surface to be detected and a source of light, a weft detecting system including two photoelectric cells and dependent for operation thereof upon simultaneous differential illumination of said cells by two beams of light of different intensities, and means effective upon exhaustion of weft causing said cells to receive said differential illumination by beams of different intensities reflected simultaneously from said source by the surface being detected.

4. In a loom having, a source of light, a light responsive electric weft detector system having two photoelectric cells effective when illuminated separately and simultaneously by beams of light of different intensities derived from said source to initiate a change in loom operation, and means by virtue of which substantial exhaustion of weft causes illumination of said cells by said beams of light of different intensities.

5. In a loom having a source of light, a weft detector system effective when the illumination of one part thereof is increased simultaneously with a decrease of illumination of another part thereof to initiate a change in loom operation, and means dependent upon substantial weft exhaustion to cause said source to effect an increase in the illumination of said one part simultaneously with a decrease in the illumination of said other part.

6. In a loom having a source of light, a bobbin having light and dark colored zones normally covered by an ample supply of weft but uncovered when the weft is depleted, and an electric weft detector system including two photoelectric cells controlled by beams of light projected from the surface being detected toward said cells and ineffective during a weft detecting period when both zones are covered by weft to cause a change in loom operation but effective when both of said zones are uncovered during a detecting period to cause a change in loom operation.

7. In an electric weft detecting system for a loom having a source of light, a bobbin having two zones of different light reflecting capacities normally covered by weft but uncovered by depletion of the weft and when uncovered causing two beams of light of different intensities to be reflected from said source, and photoelectric means effective to indicate weft exhaustion when activated by said two beams of different intensities.

8. In an electric weft detecting system for a loom, a source of light, a bobbin having two zones normally covered by weft but uncovered by depletion of the weft and when uncovered causing two beams of light of different intensities to be reflected from said source, and photoelectric means including two light responsive elements, one element for each light beam, effective when said elements are simultaneously illuminated by their respective light beams to effect indication of weft exhaustion.

9. In a loom having a source of light, an electric weft detector system including two photoelectric cells effective to indicate weft exhaustion only when said cells are acted upon by two beams of light of different intensities, and a bobbin capable of reflecting light from said source of one intensity only onto said cells when ample weft is present during the detecting period, said bobbin having two zones which when uncovered by weft exhaustion are effective to reflect two beams of light of said different intensities from said source onto said cells.

10. In an electric weft detecting system for a loom, a source of light, a pair of photoelectric cells, a bobbin having a zone effective to reflect a given degree of light from said source onto one of said cells and having another zone effective to reflect a different degree of light from said source onto the other cell when the weft of the bobbin is exhausted, and means dependent upon reflection of unequal amounts of light from said source onto said cells to indicate weft exhaustion.

11. In a loom having a source of light, two photoelectric weft detector units receiving substantially equal amounts of light from said source when an ample supply of weft is being detected, means causing said units to receive different amounts of light from said source when the weft is substantially exhausted, and means dependent upon reception of different amounts of light by said units to indicate weft exhaustion.

12. In a loom operating with two weaving shuttles one of which carries a dark colored weft and the other of which carries a light colored weft, a weft carrying bobbin in each shuttle having dark and light colored zones normally covered by weft but uncovered when the weft is exhausted, a weft detecting system including two photoelectric cells for detecting the weft of each shuttle during a detecting period effective to indicate weft exhaustion only when said cells receive different degrees of illumination, and means causing beams of light to be reflected from the bobbins onto said cells and effective upon depletion of weft of either bobbin to cause the corresponding uncovered zones to reflect said unequal degrees of illumination onto said cells.

13. In an electric weft detecting system for a loom, a source of light, a photoelectric cell on each side of and shielded from said source, a bobbin having a dark colored zone positioned during the detecting period to reflect a small amount

of light from said source onto one of said cells and having a light colored zone positioned during said detecting period to reflect a larger amount of light from said source onto the other cell, provided the bobbin is depleted of weft, and means effecting indication of weft exhaustion when said one and other cells are illuminated, respectively, by small and large amounts of light.

14. In an electric weft detecting system for a loom having a source of light, weft detecting electric circuit means which includes a photoelectric cell and is closed when the cell is subjected to a low degree only of illumination, a second weft detecting electric circuit means which includes a second photoelectric cell and is closed when said second cell is subjected to a high degree only of illumination, means effecting a change in loom operation when both of said circuit means are closed simultaneously, and means simultaneously subjecting the first and second named cells to low and high degrees of illumination, respectively, derived from said source when the weft being detected is depleted.

15. In an electric weft detecting system for a loom having a source of light, weft detecting electric circuit means which includes a photoelectric cell and is closed when the cell is subjected to a low degree only of illumination, a second weft detecting electric circuit means which includes a second photoelectric cell and is closed when the second cell is subjected to a high degree only of illumination, an electric switch for each detecting circuit means closed when the corresponding detecting circuit means is closed, loom controlling electric circuit means closed to effect a change in loom operation when both of said switches are closed, and means simultaneously subjecting the first and second named photoelectric cells to low and high degrees of illumination, respectively, derived from said source when the weft being detected is depleted.

16. In a photoelectric weft detecting system for a loom having a source of light, a pair of photoelectric detector units one of which is activated by exposure to a relatively strong beam of light and the other of which is activated by exposure to a relatively weak beam of light, a bobbin which when depleted of weft has a relatively bright surface effective to reflect a strong beam of light from said source to said one unit and also has a relatively dark surface effective to reflect a weak beam of light from said source to the other unit, and means to effect a change in loom operation when both of said units are activated.

17. In a weft detecting system for a loom having a source of light, electric means constituting a loom controlling circuit including two normally open switches in series effective when said switches are both closed during the weft detecting period to cause a change in loom operation, a relay for one of said switches, electric means including a photoelectric cell effective upon a diminution of illumination of said cell to cause said relay to close said one switch, a second relay for said other switch, other electric means including a second photoelectric cell effective upon an increase in illumination of said second cell to cause said second relay to close said other switch, and means including said source effective upon substantial exhaustion of weft to cause a decrease of illumination of the first named cell and an increase in illumination of said second cell.

18. In a weft detecting system for a loom having a source of light, a loom controlling circuit including two switches in series one of which is normally closed and the other of which is normally open, said circuit effective when both of said switches are closed during the weft detecting period to cause a change in loom operation, a relay for said one switch normally deenergized but effective when energized to open said one switch, a second relay for said other switch normally deenergized but effective when energized to close said other switch, electric means including a photoelectric cell effective upon weak illumination of said cell to enable the first relay to remain deenergized but effective upon strong illumination of said cell to energize the first named relay to open the first named switch, other electric means including a second photoelectric cell effective upon weak illumination of said second cell to enable said second relay to remain deenergized but effective upon strong illumination of the second cell to cause the second relay to close the second named switch, and means including said source effective when ample weft is present during the weft detecting period to cause both of said photoelectric cells to be subject to the same illumination, thereby causing one or the other of said switches to be open, said means effective at substantial weft exhaustion to subject the first cell to weak illumination, whereby the first switch remains closed, and subject the second cell to strong illumination to cause closure of said other switch.

19. In electric weft detecting system for a loom having a source of light, two photoelectric cells having the anode of one cell connected to the cathode of the other cell and having the anode of the other cell connected to the cathode of said one cell, means including said source effective upon substantial exhaustion of weft to subject one of said cells to weak illumination and subject the other cell to strong illumination, an electronic tube having a grid normally effective to prevent flow of current through the tube and electrically connected to said cells and effective when the illumination of said one cell is weak simultaneously with strong illumination of the other cell to permit electric current to flow through said electronic tube, a relay energized when electric current is able to flow through said electronic tube, and a loom controlling circuit closed during the weft detecting period when said relay is energized.

20. A weft bobbin for a photoelectric weft detecting system, said bobbin having two detecting zones for cooperation with said system and a source of light, one of said zones being capable of reflecting more light from said source than the other zone.

21. A weft bobbin for a photoelectric weft detecting system, said bobbin having two detecting zones possessed of widely different capacities for reflecting light from a source of light to said system.

22. A weft bobbin for a weft detecting system employing two photoelectric cells, said bobbin having two detecting zones possessed of widely different capacities for reflecting light, one of said zones being for one of said cells and the other zone being for the other cell.

23. In an electric weft detecting system for a loom, a bobbin having two zones of different light

reflecting capacities normally covered by weft but uncovered by depletion of the weft, illuminating means directing light toward both zones of the bobbin, said zones when uncovered reflecting two beams of light of different intensities, and photoelectric means including a photoelectric cell for each beam of reflected light effective to indicate exhaustion of weft when said photoelectric cells are activated by their respective beams of reflected light.

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