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2,911,013

PHOTOELECTRIC WEFT DETECTING SYSTEM FOR LOOM

Filed Dec. 23, 1957

2 Sheets-Sheet 1

FIG. 9

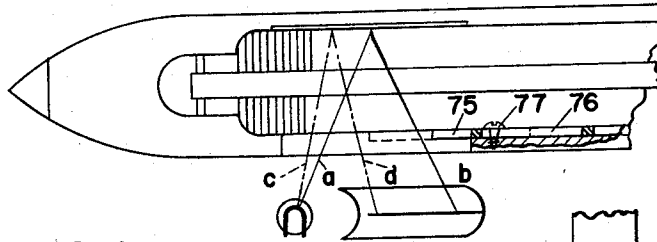


FIG. 1

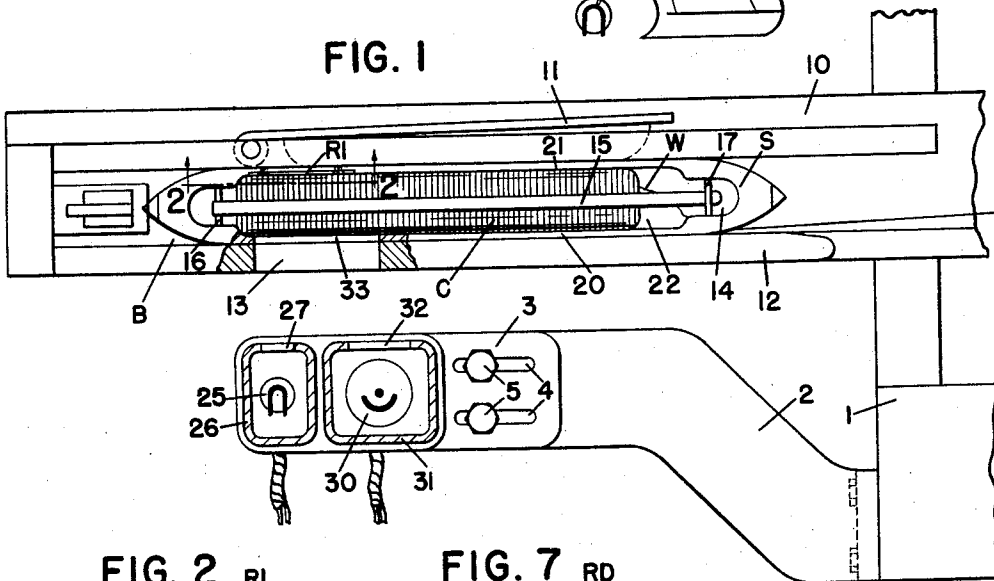


FIG. 2

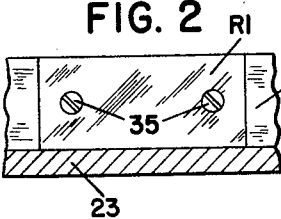


FIG. 7

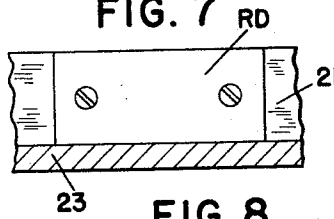


FIG. 3

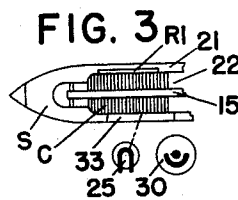


FIG. 8

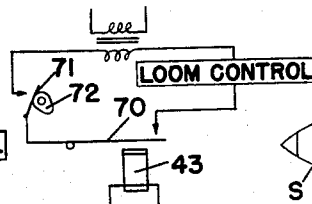


FIG. 5

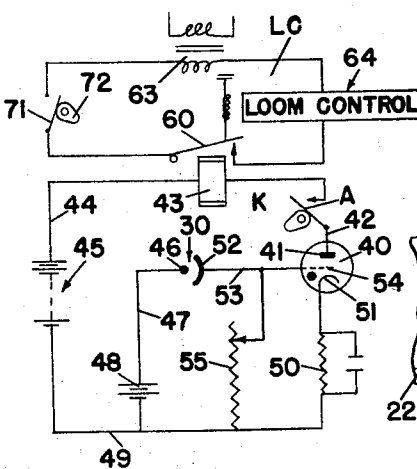


FIG. 4

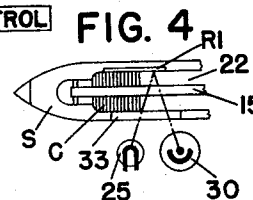
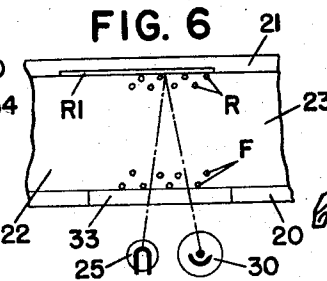


FIG. 6



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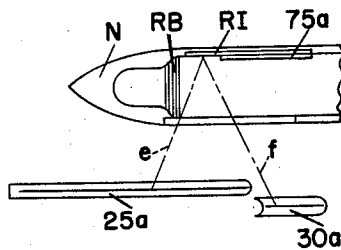


FIG. 10

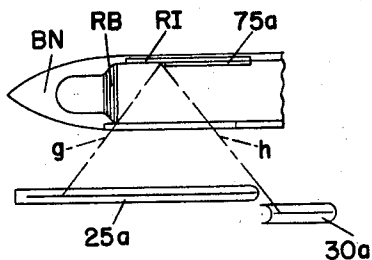


FIG. 11

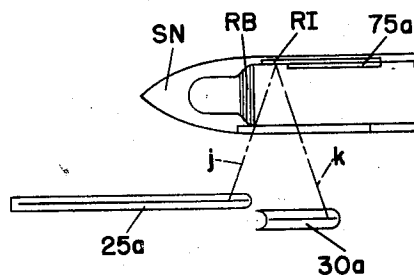


FIG. 12

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PHOTOELECTRIC WEFT DETECTING SYSTEM FOR LOOM

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Application December 23, 1957, Serial No. 704,586

18 Claims. (Cl. 139—273)

This invention relates to improvements in photoelectric weft detectors for looms and shuttle therefor.

Previously known photoelectric weft detecting systems for looms have generally required a special bobbin made either to reflect a beam of light or permit light to pass through it. In such systems each of the numerous bobbins assigned to a loom must be made either with a reflector or hole through it. In other known systems bobbins have been made of transparent material with some provision within the bobbin for reflecting a beam of light laterally through the bobbin. All of these systems are expensive because of the special bobbins they require.

It is an important object of the present invention to provide a photoelectric weft detector system which does not require any change in the ordinary weft package in the shuttle and wherein a reflecting surface is placed on the shuttle as distinguished from the bobbin as in prior practice.

It is a further object of the invention to provide a detecting system of the kind mentioned adaptable more particularly to shuttles which carry centerless cops of weft. In such shuttles the weft is ordinarily drawn from the inside of the cop and the outer shell of the cop gets thinner and thinner as the weft is payed out. The thinness of the remaining shell of weft just before depletion makes the ordinary mechanical or electrical weft detector unusable because the thin shell or cylinder of weft can not withstand the force such detectors ordinarily exert on the surface being detected. When the invention is applied to looms operating with cop-carrying shuttles a reflector is placed on one of the walls of the shuttle and the other wall is provided with a window through which a beam of light is projected toward the reflector. If sufficient weft for continued weaving remains in the shuttle the weft will intercept the light and prevent a change in the illumination of the photoelectric cell, but as the weft diminishes it ultimately exposes the reflector to cause a change in illumination of the cell which effects a change in loom operation.

It is a further object of the invention to provide a shuttle having a weft-carrying compartment and having a reflector at the back side of and facing the compartment in position to be shaded from illumination by the source of light by an ample supply of weft in the compartment. In this feature of the invention the incident ray at depletion of weft passes across the weft compartment and then is reflected back across the compartment so that the light which ultimately reaches the photoelectric cell must pass through the remaining shell or layers of weft four times. A weft detecting system operating in this way is more likely to give a true measure of the weft in the shuttle than those systems in which the reflected or transmitted light passes through only two weft layers. The invention can be used on looms having single or multiple shuttle boxes and various forms of reflectors can be employed on the shuttle.

In order that the invention may be clearly understood

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reference is made to the accompanying drawings which illustrate by way of example the two embodiments of the invention and in which:

Fig. 1 is a plan view partly in section showing the preferred form of the invention which is dependent for its operation upon an increase in the illumination of the photoelectric cell,

Fig. 2 is an enlarged detail vertical section on line 2—2, Fig. 1,

Fig. 3 is a diagrammatic view showing a sufficient amount of weft for continued weaving,

Fig. 4 is a view similar to Fig. 3 but showing a depleted weft supply,

Fig. 5 shows an example of electric circuit which can be used with the preferred form,

Fig. 6 is a diagrammatic view of a type of weft depletion other than that shown in Fig. 4,

Fig. 7 is a view similar to Fig. 2 but showing a dull reflector, as a modified form,

Fig. 8 shows a loom controlling circuit such as may be used with a dull reflector,

Fig. 9 is a diagrammatic plan view showing a shield to vary the width of the reflected light beam, and

Figs. 10, 11 and 12 are diagrammatic plan views showing the shuttle in three different positions it can occupy when boxed.

Referring particularly to Fig. 1, the stationary loom frame is indicated at 1 and has secured thereto a laterally extending stand 2 on which is secured a holder 3. The latter is provided with slots 4 to receive screws 5 tapped into the stand to permit the holder 3 to be adjusted in a right and left hand direction as viewed in Fig. 1.

The loom is provided with a lay 10 having thereon a shuttle box B including in the present instance a back shuttle binder 11 and a stationary box front 12. The box front is provided with a slot 13 having a purpose to be described.

The shuttle S as set forth herein is of the type adapted to carry a centerless cop C of weft, the weft W issuing from the center of the cop and delivered through a suitable shuttle eye 14. A releasable strap 15 is pivoted at its left end at 16 to a part of the shuttle and has its right end snapped under a retaining pin 17 carried by the shuttle. The shuttle has front and back walls 20 and 21 between which is located a weft compartment 22 which holds the cop C. The shuttle has a floor 23 forming the bottom of the compartment 22.

In the operation of the matter thus far described the shuttle is picked first from one side and then from the other and the weft of the cop C will be used up until depletion is reached at which time it is desirable to effect a change in the operation of the loom without requiring attention on the part of the weaver. Heretofore there has been no very satisfactory method for automatically determining the condition of a cop in a shuttle other than visual inspection by the weaver.

In carrying the present invention into effect the holder 3 has mounted thereon an electric source of light 25 confined within a casing 26 having a rear opening 27 through which light can be projected through the slot 13. The holder 3 also has mounted thereon a photoelectric cell 30 within a casing 31 the rear part of which is open as at 32 to receive a beam of light reflected from the shuttle. The front wall 20 of the shuttle has a window 33 therein which will register with the slot 13 when the shuttle is boxed as shown in Fig. 1.

Secured to the forward surface of the rear wall 21 of the shuttle is a reflector RI which in the preferred form of the invention may be a thin strip of polished metal held fast in position by screws 35 to permit easy removal of the reflector from wall 21. This reflector is opposite

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the window 33 and on the rear side of the weft compartment 22 and when exposed is capable of increasing the illumination of the cell 30. In another form of the invention to be described the reflector RI is replaced by a thin strip of dulled metal reflector RD capable of decreasing the illumination of cell 30. In both forms of the invention, the reflector is located within the shuttle with respect to the weft such that the reflector can be visually inspected without removing the weft from the shuttle simply by manually moving the weft slightly forwardly.

In the operation of the form of invention using reflector RI the source of light will project a beam of light rearwardly through the slot 13 and window 33 toward the weft supply in the compartment. If there is an ample supply of weft for continued weaving, see Fig. 3, the weft will intercept the incident ray of light from the source 25 and cast a shadow on the reflector RI. Because the reflector RI is located rearwardly of the supply of weft, the light from source 25 is capable of casting a shadow on the reflector. The light falling on the cell 30 will be only that reflected from the cop and this will not be enough to activate cell 30. As weft depletion approaches, however, the incident ray from the source 25 after passing through the window 33 will be projected across the compartment 22 to the reflector RI and will be reflected back through the window 33 onto the cell 30, see Fig. 4. Under this condition the cell 30 is activated and will effect a change in the loom operation, such for instance as stopping or automatic change of the shuttle.

It will be noted that when the depletion of weft is as indicated in Fig. 6 the incident and reflected rays pass through both the front and rear sides or layers F and R respectively of the depleted supply of weft so that four impedances are offered to the beam of light before it can reach the photoelectric cell. This insures a better detection of the condition of weft in the shuttle than can be had in those systems in which a beam of light is reflected directly from a ferrule on the bobbin or in which a beam of light passes from one side of the shuttle through a hole in the bobbin and out of the opposite side of the shuttle, conditions which would offer only two impedances.

Fig. 5 shows an example of a circuit which can be used with the invention but the invention is not necessarily limited to the details shown in that figure. A gas filled electronic power tube 40 has its anode 41 connected by wire 42 to one side of a normally open switch A the other side of which is connected to an electromagnetic device, such as a relay 43. The latter is connected by wire 44 to one side of a source of electric power 45. Anode 46 of the photoelectric cell 30 is connected by wire 47 to one side of another source of electric power 48 the other side of which is connected to wire 49 connected as shown to power source 45. Wire 49 is connected through resistance 50 to the cathode 51 of tube 40.

The cathode 52 of the photoelectric cell 30 is connected by wire 53 to control grid 54 in tube 40, and a resistance 55 is connected across wires 49 and 53. This part of the circuit is under joint control of the photoelectric cell and switch A and whenever the cell undergoes a change from its normal illumination occurring during the detecting interval when cam K closes switch A it will change the electric condition of the relay 43. Switch A is closed by a loom actuated cam K at regularly occurring intervals.

The loom controlling electric circuit LC is shown in the upper part of Fig. 5 and includes a normally open switch 60 closed when the electric condition of relay 43 is changed. A source of electric power 63 and loom controlling means designated generally at 64 are also included in circuit LC. The means 64 is ordinarily idle but will be actuated to change loom operation; as

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stopping or replenishing, when switch 60 is closed. The cam K may be controlled in any approved manner either by a shaft of the loom or if the invention is used with shifting shuttle boxes with some part of the loom which will close switch A upon substantially completion of the shuttle box shift.

Other forms of electric controls for looms are known in the art and may be used with the present invention and the matter set forth in Fig. 5 is given merely as one example.

The reflector RI can, if desired, be replaced by any other type of reflector such for instance as material used for picture projecting screens or sheet material having random disposed crystals some surfaces of which will always face in a direction to reflect an incident ray onto the photoelectric cell.

In the matter thus far described there has been set forth a circuit which is actuated to bring about a change in loom operation upon an increase in illumination of the photoelectric cell. The invention can, however, be used where weft depletion is accompanied by the decrease in illumination of the light responsive cell. In this modified form of the invention the bright reflector will be replaced by a dark reflector RD shown in Fig. 7 to be used in place of the reflector RI. The photoelectric circuit will be very similar to that already described except that it will be responsive to a diminution in the illumination of the photoelectric cell upon depletion of weft and when switch A is closed. It is not thought necessary to illustrate such a circuit since circuits of this kind are well understood. When such a circuit is used, however, the relay 43 will normally be energized when sufficient weft is present during the detecting interval to hold a switch 70 in open position, see Fig. 8, and upon decreased illumination of the photoelectric cell during the detecting interval the relay will become deenergized and switch 70 will close to effect a change in the loom operation similar to that already disclosed. Switch 70 as shown in Fig. 8 is in series with another switch 71 normally open but closed by another cam 72 operated by the loom in timed relation with switch A. If the relay 43 should become deenergized between detecting intervals switch 70 will close but under these conditions switch 71 will be open due to cam 72 and the loom can continue to run without change of operation. Switch 71 and its cam 72 can be used in the preferred form, as shown, but is not necessary in that form.

For further reference to photoelectric circuits which may be used either with increased or decreased illumination reference may be had to a publication of the Radio Corporation of America, copyrighted 1940, Form PT-20R1, entitled "RCA Phototubes," page 7 for increased illumination and page 10 for decreased illumination.

Photoelectric weft detectors of the type already described can be used on looms operating with two or more shuttles wherein one of the shuttles carries relatively fine weft the reserve bunch of which will be small while another shuttle may carry relatively coarse weft requiring a larger reserve bunch. Under these conditions it is desirable to provide some adjustment for the width of the reflected beam to permit both types of weft to be efficiently detected. This can be accomplished as set forth in Fig. 9 wherein a shield 75 is fastened to the inside of the front wall of the shuttle and provided with a slot 76 which receives a screw 77 threaded into the shuttle and permitting lengthwise adjustment of the shield so that the width of the reflected beam of light through slots 13 and 33 can be made narrower when fine yarns are being woven. The photoelectric tube will preferably be horizontally disposed so that its cathode will extend lengthwise of the shuttle. When coarse weft is being woven in a shuttle the shield will be moved to its least shielding position, shown in full lines in Fig. 9, so that light beam *a* can be reflected at *b* on the cathode. When

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fine weft is being woven the shield can be moved in toward the center of the slot in the shuttle, dotted lines, Fig. 9, thus requiring more depletion of the bunch of the fine weft before the incident ray C can be reflected at *d* on the cathode of the photoelectric cell. The shield could, of course, be on the rear wall close to the reflector, as shown in Figs. 10-12.

In the operation of a loom the shuttle is not always properly boxed during the weft detecting period and it is desirable under such conditions to provide a detecting system which will be operative whether the shuttle be in normal position or in an abnormal position. In Fig. 10 a shuttle is shown in normal boxed position designated at N; in Fig. 11 the shuttle is shown as deeply boxed beyond normal, designated by BN, a condition which might result from a badly worn picker; and in Fig. 12 the shuttle is shown as being short of normal, designated at SN, a condition which might result from a weak pick from the other side of the loom or a rebounding of the shuttle.

In order that the detecting system might operate with the shuttle in all three of these positions the source of light 25*a* may be made as indicated with a long filament which may be substantially parallel to the shuttle. The photoelectric cell 30*a* may be located as shown diagrammatically in Figs. 10-12. In Fig. 10 the incident ray light *e* originates from an intermediate point along the length of the light source 25*a* and is reflected from the exposed part of the reflector RI when the reserve bunch RB has been reached. Under these conditions the reflected ray *f* will fall on the cell 30*a* to give indication of exhaustion.

In Fig. 11 the incident ray *g* comes from a part of the filament of the light source 25*a* to the left of beam *e* and the reflecting ray *h* will fall on the photoelectric cell. In Fig. 12 the incident ray *j* will come from the right-hand part of the filament of the light source 25*a* and be reflected on the photoelectric cell along the line designated at *k*. The cell 30*a* will therefore be activated when the shuttle is in any of the three positions shown.

In Figs. 10-12 the reflector is of the kind which causes an increase in the illumination of the photoelectric cell, but the same general principle can be used if the cell is to be activated by a decreased illumination. Also, a shield 75*a* similar to shield 75 is mounted on the rear wall of the shuttle in a manner similar to that already described in connection with Fig. 9 and can be adjusted depending upon whether the shuttle is provided with coarse or fine weft. As shown, fine weft is contemplated but coarse weft could be used with only slight modification of the proportion shown.

From the foregoing it will be seen that the invention sets forth simple means by which a reflector on the shuttle in position to be shaded by an ample supply of weft acts to reflect a beam of light on a photoelectric cell whenever the weft supply becomes depleted. By this arrangement a single reflector on the shuttle can take the place of the many reflectors on bobbins in previously known systems. Also, the weft supply need not be changed in any way from the form which it ordinarily takes, being in this respect different from previously known systems which have required some alteration such as a reflecting surface on a bobbin, a hole through the bobbin, or a transparent bobbin. The reflector on the shuttle not only greatly reduces the cost of the system but also offers a single surface to be cleaned instead of a multitude of surfaces as is the case when bobbins are provided with highly reflective metallic ferrules. The invention also sets forth a shuttle having a weft compartment between front and back side walls in one of which is located a window and on the other of which is located a reflector in a position to be shaded by weft in the compartment.

Also, the shuttle is provided with a shield to vary the width of the reflected beam to adapt the system for use

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with coarse or fine weft. Furthermore, the system is adapted to operate efficiently whether the shuttle when boxed is located in normal position, or beyond, or short of, normal position. The photoelectric cell can call a change in loom operation whether its illumination be increased as in the preferred form, or decreased as in the modified form. The reflector can be made concave toward the weft compartment to concentrate the light beam on the photoelectric cell.

Having now particularly described and ascertained the nature of the invention and in what manner the same is to be performed, what is claimed is:

1. In a weft detecting system for a loom having regularly recurring detecting intervals, the system having a source of light and a light sensitive element effective upon an abnormal degree of illumination thereof during a detecting interval to change operation of the loom, a shuttle having a front and a rear wall with a window in one wall exposing weft in the shuttle to light from said source, the weft when present in sufficient amount reflecting a normal degree of illumination from said source onto said cell during detecting intervals, the other wall having a surface opposite the window which when exposed to light from said source due to depletion of weft reflects said abnormal degree of light on said cell, whereupon the latter causes said change in operation of the loom.

2. In a weft detecting means for a loom, a shuttle having a window in a wall thereof, a reflector on an opposite wall of the shuttle positioned to reflect back through the window an incident ray of light falling thereon after passing through the window, the shuttle constructed to hold a cop of weft which when present in sufficient amount for continued weaving intercepts an incident ray of light but when depleted permits the incident ray to fall on the reflector and be reflected back through the window, and a loom controlling photoelectric cell positioned to have the illumination thereof changed by the reflected ray and thereupon effecting a change in loom operation.

3. In a detecting means for the weft of a loom, a shuttle having front and back side walls adapted to hold a centerless weft cop between the walls, a window in one side wall of the shuttle, a reflector secured to the other side wall opposite the window in position to have a beam of light entering the window fall thereon and be reflected back through the window, provided the weft supply is depleted, and light responsive means to effect a change in loom operation when a beam of light is reflected from the reflector back through said window.

4. In a weft detecting system for a loom having a source of light, a shuttle having front and rear walls, a reflector on the forward surface of said rear wall and in the shadow cast by the light source of a sufficient supply of weft in the shuttle but exposed to reflect a beam of light from said source when the supply of weft is depleted, and light responsive means to cause a change in loom operation when the reflector reflects a beam of light from said source onto said responsive means, the reflector being located rearward of said supply of weft to enable said light source to cast said shadow.

5. In a loom weft detecting system having a light source and a light sensitive element effective upon increased illumination to change operation of the loom, a shuttle having a front and a rear wall to hold a supply of weft which is consumed during operation of the loom, and a reflector means secured to the rear wall of the shuttle shaded from light from the source by a sufficient supply of weft and incapable of increasing illumination of the sensitive element but effective to reflect light from the source onto the element to increase its illumination when the weft is depleted, said reflector means being located within said shuttle with respect to said weft such that the reflector is capable of visual inspection without removal of the weft from the shuttle.

6. In a shuttle for a loom having a weft detecting system dependent for its operation upon reflecting a beam of light from a light source onto a photoelectric cell, front and back walls of the shuttle defining a weft cop-receiving compartment, a window in one of said shuttle walls through which a beam of light from said source can pass, and a reflector on the other shuttle wall positioned to reflect through said window onto the cell a beam of light passing from said source through the window across said compartment and falling onto the reflector.

7. In a shuttle for a loom having a weft detecting system dependent for its operation upon reflecting a beam of light from a light source onto a photoelectric cell, front and back walls of the shuttle defining a weft cop-receiving compartment, a light reflector on one of said walls facing the compartment, the other wall having a window therein aligned transversely of the compartment with the reflector enabling a beam of light from the source to pass across the compartment and be reflected from the reflector back across the compartment through the window onto said cell.

8. In a shuttle having a weft cop-receiving compartment for use in a loom having a weft detecting system dependent for its operation upon reflecting a beam of light from a light source onto a photoelectric cell, a light reflector on the shuttle at one side of said compartment in position to be shaded from light from said light source by a sufficient supply of weft in the compartment and reflect a beam of light from said source across said compartment onto the cell when the weft in the compartment is depleted.

9. In a shuttle having a weft cop-receiving compartment for use in a loom having a weft detecting system dependent for its operation upon reflecting a beam of light from a light source onto a photoelectric cell, a light reflector fixed to the rear wall of the shuttle facing the compartment at the back side thereof and in position to reflect a beam from the light source crossing the compartment and falling on the reflector back across the compartment onto said cell.

10. The shuttle set forth in claim 9 wherein the reflector is a thin strip of dulled metal on said wall and reflects more light than is reflected by the weft.

11. The shuttle set forth in claim 9 wherein the reflector is a thin strip of dulled metal on said wall and reflects less light than is reflected from the weft.

12. In a loom weft detecting system having a light source and a light sensitive element effective upon a decreased illumination to change operation of the loom, a shuttle having forward and rearward walls and holding a supply of weft, and a dull reflector on the forward surface of said rear wall of the shuttle shaded from said light source by a sufficient supply of weft in the shuttle and when so shaded ineffective to cause the sensitive element to change loom operation, said reflector when exposed to light from said source due to depletion of weft in the shuttle reflecting decreased light on the sensitive element, whereupon the latter causes a change in loom operation.

13. In a shuttle having a weft cop-receiving compartment for use in a loom having a weft detecting system dependent for its operation upon reflecting a beam of light from a light source onto a photoelectric cell, a light reflector on the shuttle facing the compartment and in position to reflect a beam from the light source cross-

ing the compartment and falling on the reflector back across the compartment onto said cell, and a shield on the shuttle adjustable lengthwise of the shuttle to vary the width of the reflected beam.

14. In a shuttle for a loom having a weft detecting system dependent for its operation upon reflecting a beam of light from a light source onto a photoelectric cell; front and back walls of the shuttle defining a weft cop-receiving compartment, a window in one of said shuttle walls through which a beam of light from said source can pass, a reflector on the other shuttle wall positioned to reflect through said window onto the cell a beam of light passing from said source through the window across said compartment and falling onto the reflector, and a shield on one of said walls adjustable lengthwise of the shuttle to vary the width of the beam of light reflected from the reflector onto the photoelectric cell.

15. In a loom weft detecting system having a light sensitive element effective upon a change in the illumination thereof to change operation of the loom, a shuttle having a front and a rear wall and carrying a weft supply capable in picking operations of the loom of occupying a boxed position which is either normal, or deeply boxed beyond the normal, or insufficiently boxed short of the normal, a reflector fast to said rear wall of said shuttle but easily removable therefrom and in position to be shaded by a sufficient supply of weft but exposed when the weft supply is depleted, and a source of light effective when the weft is depleted to cause the reflector to change the illumination of said sensitive element whether the shuttle in its boxed position be normal, beyond normal, or short of normal.

16. The detecting system set forth in claim 15 wherein the source of light is elongated in a direction lengthwise of the shuttle.

17. The detecting system set forth in claim 15 wherein the source of light is a lamp having an elongated filament extending in a direction substantially parallel to the shuttle.

18. In a loom weft detecting system having a light sensitive element effective upon a change in the illumination thereof to change operation of the loom, a shuttle having a weft compartment for a cop weft supply capable in picking operations of the loom of occupying a boxed position which is either normal, or deeply boxed beyond the normal, or insufficiently boxed short of the normal, a reflector on the shuttle at one side of the compartment in position to be shaded by a sufficient supply of weft but exposed when the weft supply is depleted, and a source of light effective when the weft is depleted to cause the reflector to change the illumination of said sensitive element whether the shuttle in its boxed position be normal, beyond normal, or short of normal.

References Cited in the file of this patent

UNITED STATES PATENTS

2,026,146	Turner	Dec. 31, 1935
2,613,692	Anderson	Oct. 14, 1952
2,766,781	Laraia et al.	Oct. 16, 1956

FOREIGN PATENTS

405,757	Great Britain	Feb. 15, 1934
876,679	Germany	May 18, 1953