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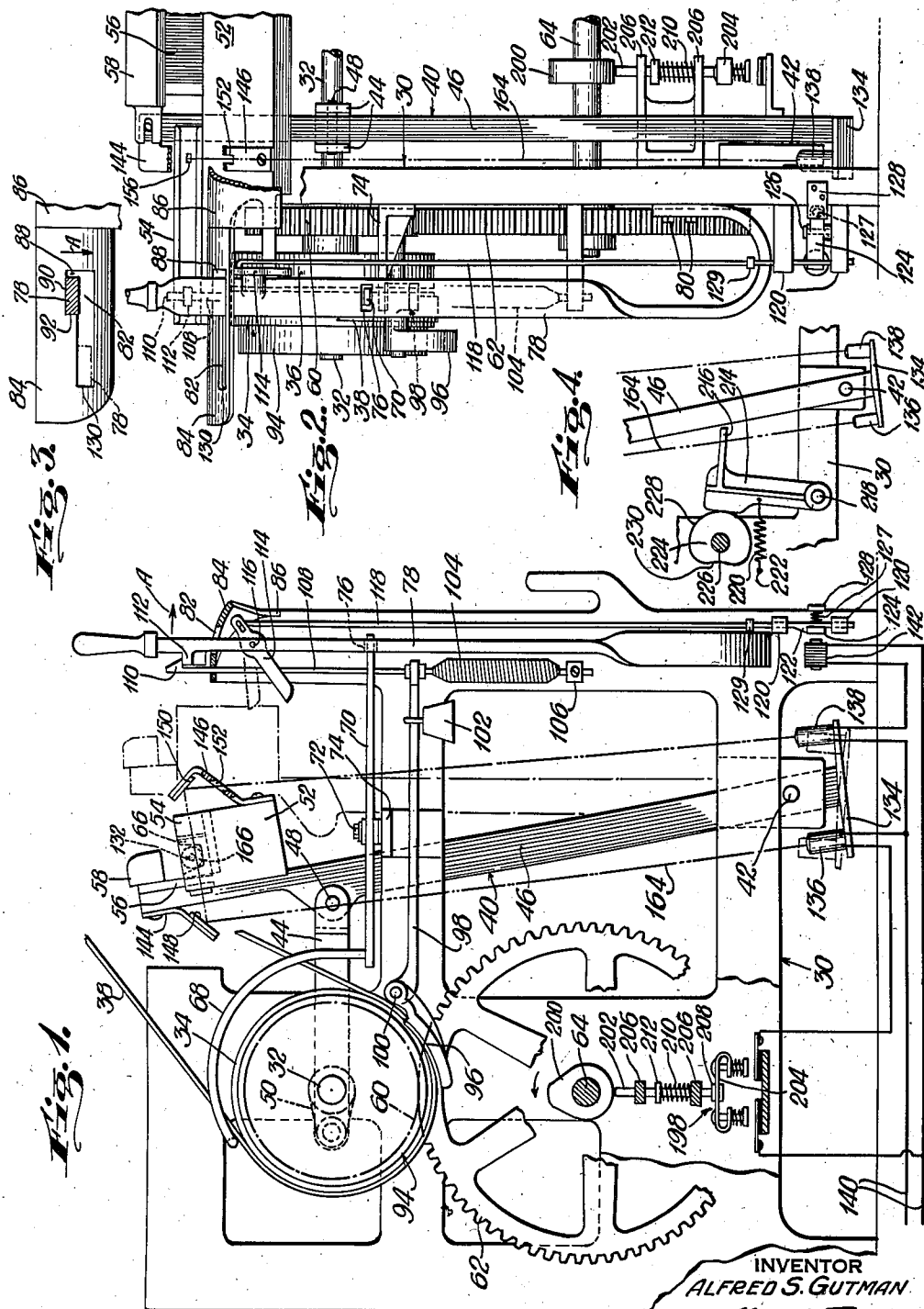
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PROTECTOR MECHANISM FOR LOOMS

Filed March 30, 1940

4 Sheets-Sheet 1



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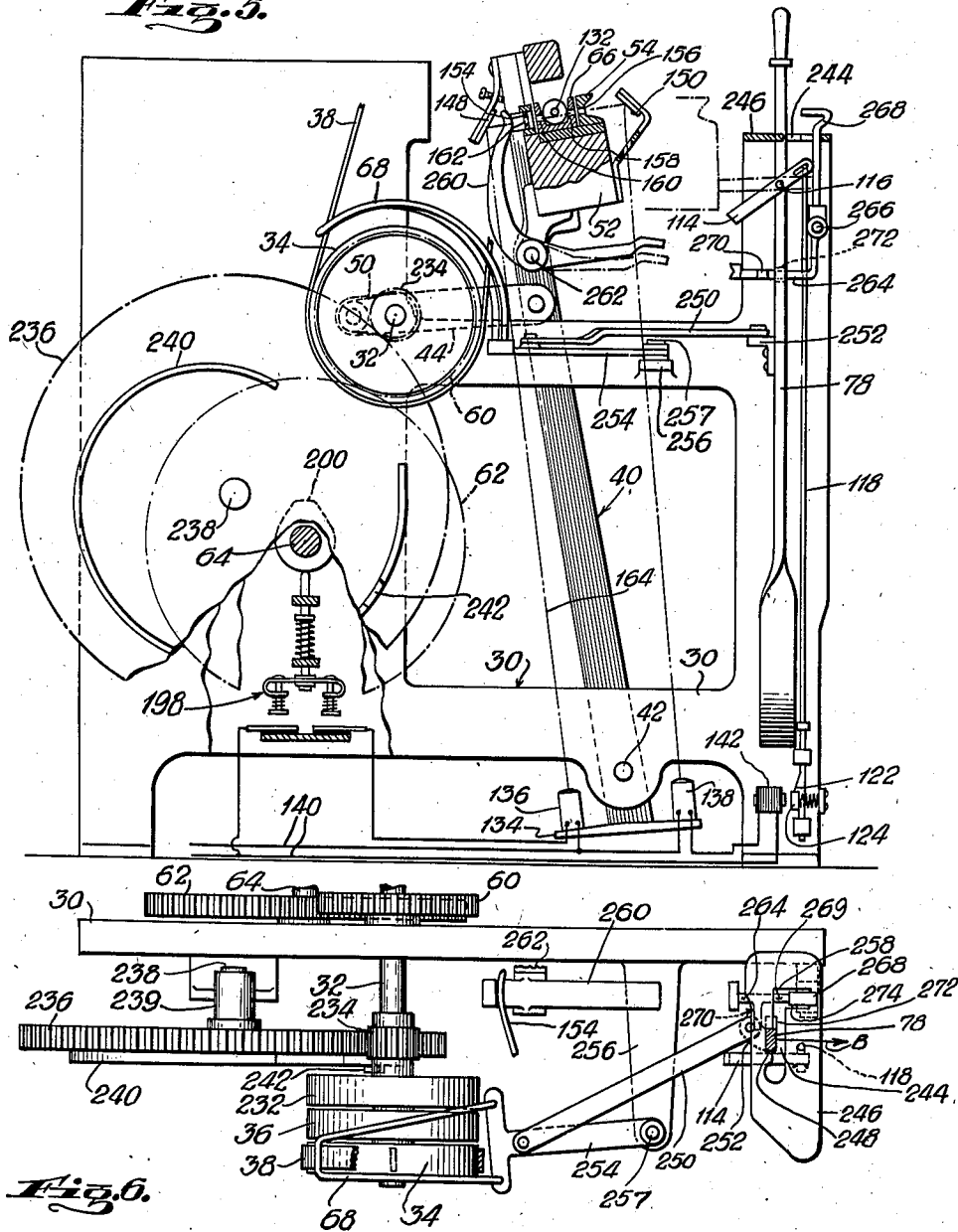
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Fig. 5.



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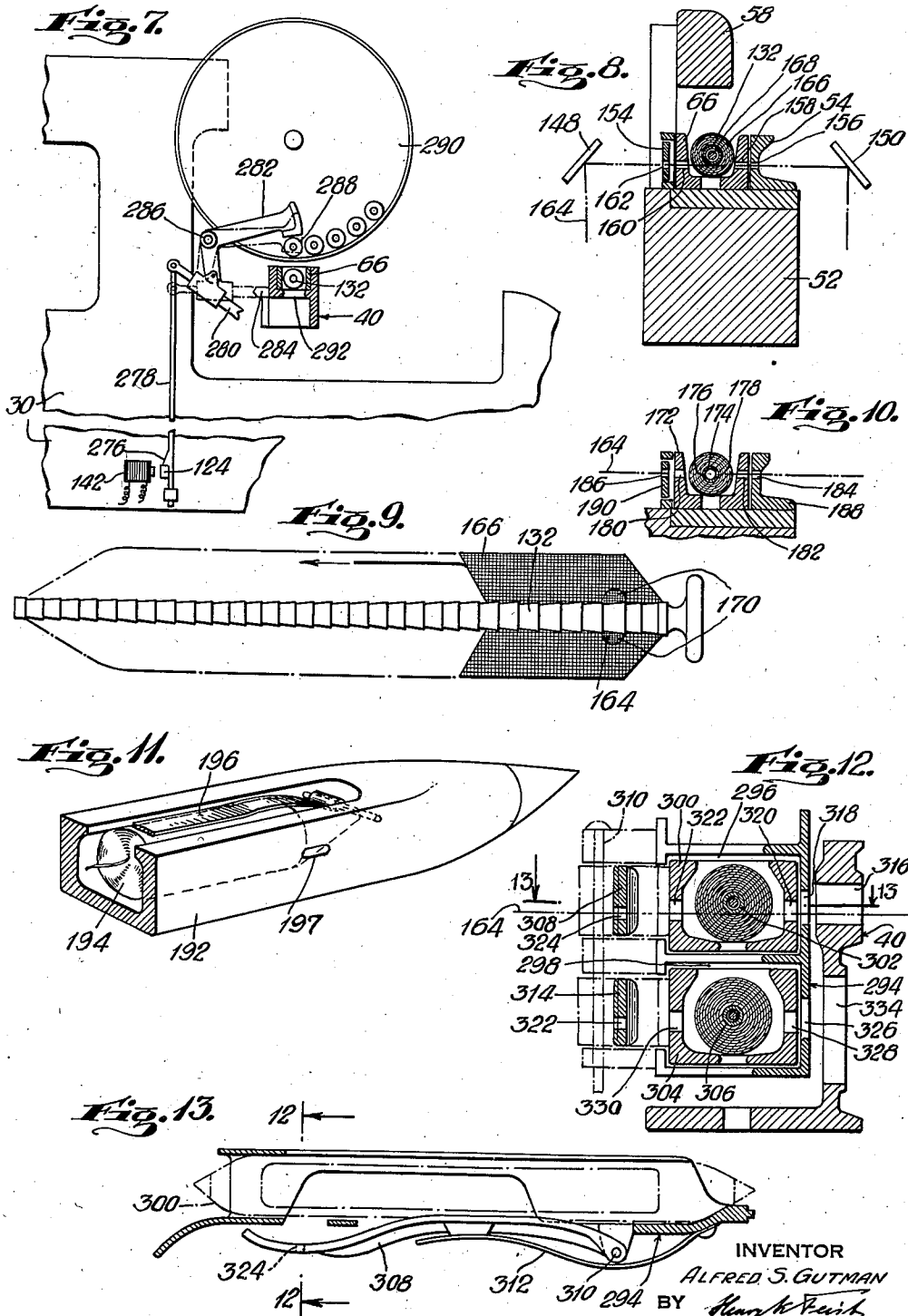
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PROTECTOR MECHANISM FOR LOOMS

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4 Sheets-Sheet 3



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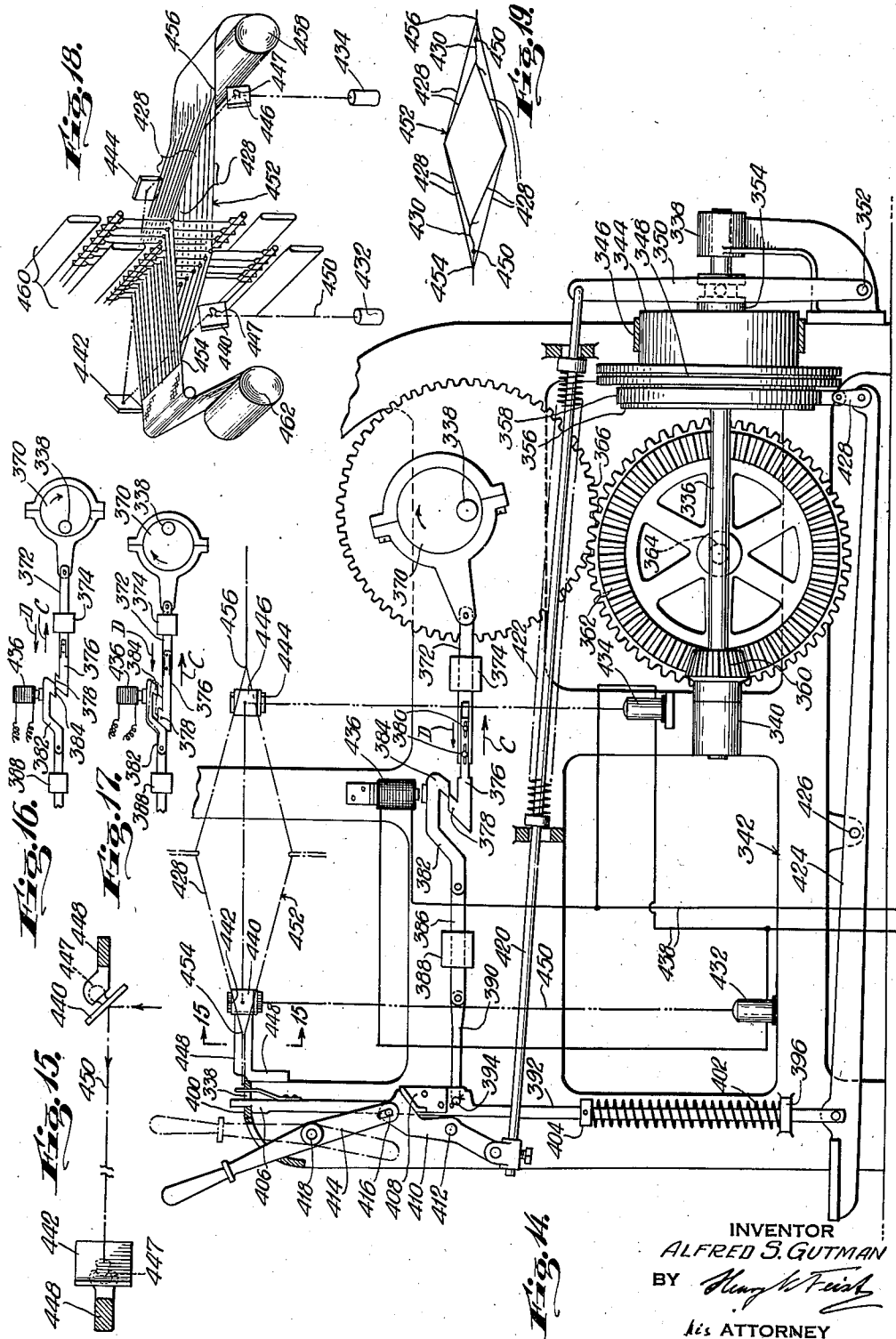
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UNITED STATES PATENT OFFICE

2,279,675

PROTECTOR MECHANISM FOR LOOMS

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Application March 30, 1940, Serial No. 326,893

12 Claims. (Cl. 139—336)

My invention relates to looms, and more particularly to a protector mechanism for looms and to a method of controlling the operation of looms.

During the operation of a loom various changes of the yarn arrangement may occur which require a control of the operation of the loom. For example, a breakage of a weft yarn or a warp yarn requiring the stoppage of a loom may occur, or a cop may become exhausted, so that, according to the type of the loom used, either the loom must be stopped or an automatic weft supply motion or an automatic shuttle change motion must be rendered active.

The hitherto known protector mechanisms responding to a change of the yarn arrangement have the disadvantage of causing a damage to the yarn by the mechanical action of the feeler of the protector mechanism or by electric sparks causing a discoloration of yarns of delicate colors. Moreover, it is practically impossible to apply the hitherto known weft protector mechanism to looms with box motion on both sides of the loom or to looms for duck weaving by means of tubular cops. Furthermore, the conventional warp stop motions with drop wires can be used only for the control of the warp yarns in the rear portion of the shed but cannot be used for the control of the warp yarns in the front portion of the shed. Moreover, if a warp yarn breaks and the warp stop motion does not act immediately, the broken warp yarn becomes entangled with other warp yarns of the shed and causes the formation of a so-called float by disturbing the regular shedding motion of said warp yarns. Very often, such a float prevents the drop-wires of the conventional warp stop motion from falling down, so that the warp stop motion is rendered inoperative, when the most severe faults in weaving occur. In a special warp stop motion known in the art the so-called drop wires cause a stoppage of the loom, either if they fall down due to a breakage of the warp yarn, or if they are raised due to a stretching of the warp yarn occurring after the formation of a float. This special warp stop motion may be used only for the control of the yarns in the rear portion of the shed as is true of the conventional warp stop motions. There are no stop motions known in the art, which may be used for the control of the yarns in the front corner of the shed where the so-called float occurs, and which are directly rendered active by the float per se and may cause an immediate stoppage of the loom before a

stretching of the warp yarns occurs after the formation of the float.

An object of my invention is to provide a protector mechanism for looms, by means of which the above enumerated disadvantages of the hitherto known protector mechanisms are eliminated.

In order to carry out my invention into practice, I provide in combination with a loom: a protector mechanism comprising electric circuits including a photoelectric element, a source of light adapted to project a beam upon said photoelectric element, and electric means for controlling the operation of the loom upon control of the electric circuit by said photoelectric element; said source of light and said photoelectric element being arranged in such a way as to direct the path of the beam through a place of the loom indicating any change of the yarn arrangement requiring the control of the operation of the loom.

The above object as well as others not particularly pointed out will appear from the following description with reference to the accompanying drawings in which only those parts necessary to a complete understanding of the invention are shown and in which:

Fig. 1 is a side end elevational view of a loom equipped with my new weft stop motion, some parts being broken away,

Fig. 2 is a fragmentary front end elevational view of the loom shown in Fig. 1,

Fig. 3 is a fragmentary detail view, in top plan, of the locking means for the stopping handle of the loom shown in Figs. 1 and 2,

Fig. 4 is a detail view of a modified timing means for rendering operative the electro-optical system of my weft stop motion at recurring intervals of the operation of the loom.

Fig. 5 is an end elevation of a loom equipped with my new weft protector mechanism in combination with an automatic shuttle change motion,

Fig. 6 is a fragmentary top plan view of the loom shown in Fig. 5,

Fig. 7 is a fragmentary end elevation of a loom equipped with an automatic weft supply motion to be controlled by my weft protector mechanism,

Fig. 8 is an enlarged cross-sectional view of the upper portion of the slay and the shuttle box containing a shuttle with a spindle and a bobbin mounted thereon, as shown in Fig. 1,

Fig. 9 shows a bobbin with yarn wound thereon partly in section,

Fig. 10 is a fragmentary cross-sectional view of the slay, shuttle box and shuttle similar to that shown in Fig. 8, in which, however, the shuttle has no spindle and the light beam is directed in a different manner,

Fig. 11 is a perspective view of a portion of a shuttle with a tubular cop arranged therein,

Fig. 12 is a cross-sectional view of a movable shuttle box with two compartments, taken on line 12—12 of Fig. 13,

Fig. 13 is a cross-sectional view of the movable shuttle box, taken on line 13—13 of Fig. 12,

Fig. 14 is a side end view of a loom equipped with my new warp stop motion,

Fig. 15 is a detail cross-sectional view of the mirror arrangement, taken on line 15—15 of Fig. 14,

Figs. 16 and 17 illustrate various positions of the members of the coupling between the electro magnet of the electro-optical system and the stopping mechanism,

Fig. 18 is a diagrammatic perspective view of the shed and the mirror arrangement in the loom shown in Fig. 14, and

Fig. 19 is a diagrammatic end elevation of the shed with floats.

Referring now to Figs. 1—3, 30 generally indicates the frame of a loom. A main shaft 32 journaled in said frame 30 carries a tight pulley 34 and a loose pulley 36. A belt 38 engaged with the tight pulley 34 and driven by a suitable driving mechanism (not shown) serves to rotate the main shaft 32 through the medium of the tight pulley.

40 generally indicates the slay structure pivotally connected to the frame 30 at 42. On each side of the slay structure the forked end of a crank arm 44 is pivoted to the slay sword 46 at 48. The other end of each crank arm 44 is movably connected with a crank 50 of the main shaft 32, so that a rotation of the main shaft causes reciprocatory movements of the slay structure 40 about the pivot 42. The slay beam 52, the shuttle box 54, the reed 56 and the slay cap 58 are arranged in the slay structure in conventional manner.

A gear 60 keyed to the main shaft 32 meshes with a gear 62 keyed to a picking shaft 64 journaled in the frame 30 of the loom. Said picking shaft 64 operates a conventional picking motion (not shown), by means of which the shuttle 66 is driven along the slay beam 52 from the shuttle box at one end of the slay structure into the shuttle box at the other end of the slay structure.

The belt 38 may be shifted from the tight pulley 34 to the loose pulley 36 and vice versa by means of a belt shifter 68 connected to one end of a lever 70 pivotally mounted at 72 on a bracket 74 attached to the frame 30. The other end of said lever 70 passes through a slot 76 of a stopping handle 78 of resilient material having its lower twisted end secured to the frame 30 by means of screws 80. The upper end of said stopping handle 78 extends through an aperture 82 of an extension 84 of a breast beam plate 86 mounted on the frame 30. The aperture 82 has a recess 88 with the edges 90 and 92 as best shown in Fig. 3. If it is desired to start the loom, the upper end of the stopping handle 78 is brought into said recess 88 as shown in full lines in Fig. 3, whereby the belt shifter 68 is moved to bring the belt 38 in engagement with the tight pulley 34. The resiliency inherent to the stopping handle 78 causes a bearing of the upper end of the stopping handle against the

edges 90 and 92 of the recess 88, so that the stopping handle is locked in its position during normal operation of the loom.

A brake drum 94 is keyed to the main shaft 32. A brake shoe 96 connected with a brake lever 98 is swingably mounted at 100. Said brake lever 98 is subjected to the load of an adjustable weight 102 and a tension spring 104 stretched between the free end of the brake lever and a stationary point 106. A rod 108 connected to the brake lever 98 has a hook 110 at its upper free end for engagement with a lug 112 arranged on the stopping handle 78. When, during normal operation of the loom, the hook 110 and the lug 112 are engaged with each other as shown in Fig. 1, the brake shoe 96 is disengaged from the brake drum 94 and the brake mechanism is rendered inactive.

A catching member or stop rod nib 114 is swingably mounted on the stopping handle 78 at 116. One end of said stop rod nib is movably connected with the upper end of a drop rod 118 slidably mounted in bearings 120 secured to the frame 30. The lower end of said drop rod 118 carries a lug 122 for engagement with a controlling means 124. As best shown in Fig. 2, said controlling means 124 has the shape of a double armed lever swingably mounted on a pivot 126 secured to the lower bearing 120. One end of said double armed lever 124 may be engaged with the lug 122, as shown in Fig. 1, in order to hold the drop rod 118 in an elevated position, whereby the stop rod nib 114 is brought into the position shown in full lines and the stopping mechanism is rendered inactive, as the free end of the stop rod nib is out of the path of the oscillating slay structure 40. A pressure spring 127 disposed between the other end of the double armed lever 124 and a plate 128 secured to the frame 30 tends to hold the lever 124 in engagement with the lug 122, so that the drop rod 118 and the stop rod nib 114 are locked in their positions during the normal operation of the loom.

When the lever 124 is disengaged from the lug 122 in a manner to be described hereinafter, the drop rod 118 falls down until a stop 129 secured to the drop rod 118 abuts against the upper bearing 120, whereby the stop rod nib 114 is swung into the position shown in dash and dotted lines in Fig. 1. Now, the stop rod nib 114 is in the path of the slay beam 52, and the latter hits the stop rod nib 114 during its next forward movement as shown in dash and dotted lines, so that the stopping handle 78 connected with the stop rod nib 114 is moved in the direction of the arrow A as shown in Figs. 1 and 3. This movement of the stopping handle 78 causes a disengagement of the latter from the edges 90 and 92 of the recess 88, and, owing to the resiliency inherent to the stopping handle 78, the latter is moved in the oblong portion of the aperture 82 against the edge 130. During this movement of the stopping handle 78 into the position shown in dash and dotted lines in Fig. 3, the lever 70 is rotated about the pivot 72, whereby the belt shifter 68 is moved to bring the belt 38 in engagement with the loose pulley 36. At the same time, the hook 110 of the rod 108 is disengaged from the lug 112 of the stopping handle 78, so that the brake shoe 96 is engaged with the brake drum 94 by means of the spring 104 and the weight 102. Thus, the stopping mechanism is rendered active and the loom is stopped. In order to render the stopping mechanism

active in the above described manner when the bobbin 132 of the shuttle 66 becomes exhausted and the shuttle is in the shuttle box 54, I provide the following electro-optical system.

A bracket 134 is secured to the lower end of the slay sword 46 near the pivotal connection 42 between the slay structure and the frame 30. The ends of said bracket 134 project on each side of the slay sword. An electric light source 135 is mounted on one end of said bracket 134, a photoelectric element or electric eye 138 is mounted on the other end of said bracket. Thus, the light source and the electric eye are arranged in such a way, that their motion and vibration is reduced to a minimum. Preferably, means (not shown) are provided to adjust the positions of the light and the electric eye. Said light and said electric eye are arranged in suitable electric circuits 140 supplied with current by an electric source (not shown). Furthermore, an electromagnet 142 is arranged in the electric circuit controlled by the electric eye 138. If the electromagnet is excited upon closing of the electric circuit by the electric eye 138, the lever 124 forming the armature of the electromagnet is attracted and becomes disengaged from the lug 122 of the drop rod 118, so that the loom is stopped in the manner described above.

Brackets 144 and 146 carrying optical means or mirrors 148 and 150 are mounted on the slay structure 40. Preferably means (not shown) are provided to adjust the positions of said mirrors. The bracket 146 is provided with a slot 152. As best shown in Fig. 8, the shuttle box 54, the shuttle 66 and a shuttle binder 154 pivotally connected to the shuttle box 54 in conventional manner are provided with openings 156, 158, 160, 162 registering with each other when the shuttle is in its end position in said shuttle box. A light beam 164 emanating from the light source 135 is reflected by the first mirror 148 and is directed through the registering openings 156, 158, 160, 162 toward the second mirror 150, when the space normally occupied by the cop or yarn 166 wound on the bobbin 132 is empty. The beam reflected by the second mirror 150 is directed through the slot 152 toward the electric eye 138.

As best shown in Fig. 8, the hollow bobbin 132 is mounted on a spindle 168 of the shuttle 66, and the mirrors 148, 150 and the openings 156, 158, 160, 162 are arranged in such a way, that the light beam 164 is directed outside the bobbin 132 adjacent the surface thereof. According to Fig. 9 illustrating an enlarged longitudinal view of the bobbin 132 with the yarn 166 wound on it the light beam 164 is directed through the space normally occupied by the yarn reserve 170 when the shuttle is in the shuttle box. As long as the yarn reserve 170 is on the bobbin, the light beam is interrupted by the yarn reserve and cannot reach the electric eye. When after the unwinding of all of the yarn 166 and a portion of the yarn reserve 170 the bobbin becomes exhausted, the light beam may reach the electric eye 138, so that the electromagnet 142 is excited and causes the actuation of the stopping mechanism.

Fig. 10 illustrates a different embodiment of a shuttle 172 with a bobbin 174 wherein the shuttle has no spindle. In such a case the portion of the bobbin 174 receiving the yarn reserve may be provided with openings 176 and 178 capable of registering with openings 180, 182, 184, 186 of the shuttle 172, the shuttle box 188 and the shuttle binder 190, so that the path of the light beam 164 is unobstructed when the yarn 166 and a portion of the yarn reserve are unwound from the bobbin.

Fig. 11 illustrates a shuttle 192 with a tubular cop 194 held in the shuttle by a holder 196 in a manner known per se. There is no bobbin in the shuttle. The shuttle 192 is provided with an oblong opening 197 on each side of the shuttle near the end of the cop which cannot be used for weaving and must be thrown away as waste. The openings 197 register with openings of the shuttle box and shuttle binder when the shuttle is in its end position. As soon as the main portion of the cop 194 and the first portion of the end of the cop is used up, the light beam may pass through the openings 197, so that the circuit of the electromagnet is closed by the electric eye and the loom is stopped.

In order to prevent an actuation of the stopping mechanism by the above described electro-optical system when the shuttle with its bobbin or cop is not in the shuttle box associated with the electro-optical system and the path of the light beam would not be interrupted by the yarn, I provide timing means for rendering operative the electro-optical system only at recurring intervals of the operation of the loom, i. e. at the intervals when the shuttle is in the shuttle box. In the embodiment shown in Figs. 1 and 2 said timing means comprise a switch 198 arranged in the electric circuit of the system and actuated by a cam 200 keyed to the picking shaft 64. A rod 202 carrying the bridge 204 of the switch 198 is slidably mounted in bores of the arms of a bracket 206 attached to the frame of the loom. A piece 208 of insulating material is arranged between the bridge 204 and the rod 202. A pressure spring 210 interposed between the lower arm of the bracket 206 and a collar 212 secured to the rod 202 tends to hold the switch 198 in open position and to urge the upper end of the rod 202 against the cam 200. The cam 200 is arranged in such a manner, that its raised portion moves the rod 202 downward against the action of the spring 210 during the interval when the shuttle is in the shuttle box. The downward movement of the rod 202 causes a closing of the circuit by the switch 198, so that the electro-optical system is rendered operative at each time when the shuttle is in the box. As long as the switch is in the open position shown in Figs. 1 and 2, the circuits are interrupted and the electro-optical system is rendered inoperative, so that the weft stop motion cannot cause a stoppage of a loom when the shuttle is not in the shuttle box.

Instead of arranging a timing switch in the electric circuit of the electric light and/or electric eye, various different timing means could be used. For example, as shown in Fig. 4, an interrupting means or a lever 214 provided with an extension 216 could be pivotally mounted on the frame 30 at 218. A tension spring 220 stretched between the lever 214 and a stationary point 222 tends to urge the lever 214 against a cam 224 keyed to a shaft 226 rotating at the same speed as the picking shaft. The cam 224 has a round portion 228 and a flattened portion 230. As long as the round portion is in engagement with the lever 214, the extension 216 of said lever is held in the path of the light beam 164 as shown in Fig. 4, so that the latter is interrupted and the electro-optical system is rendered inoperative.

During this interval when the shuttle is in the shuttle box, the flattened portion 230 of the cam 224 comes in engagement with the lever 214, so that the extension 216 comes out of the path of the beam 164 and the electro-optical system is rendered operative.

The operation of above described weft stop motion is as follows: During the normal operation of the loom, the lever 124 is in engagement with the lug 122 to hold the stop rod nib 114 out of the path of the oscillating slay structure 40 as shown in full lines in Fig. 1. The electro-optical system 136, 138, 140, 142, 148, 150 is rendered operative by the timing switch 198 at recurring intervals of the operation of the loom when the shuttle is in the shuttle box. As long as sufficient yarn is on the cop or bobbin in the shuttle, the path of the light beam 164 is interrupted by the yarn when the shuttle is in the shuttle box and the electromagnet 142 is not excited. When, however, the cop or bobbin becomes exhausted and a portion of the yarn reserve is used up, the light beam 164 projected from the light source 136 reaches the electric eye 138 when the shuttle is in the shuttle box, whereupon the electric circuit of the electromagnet 142 is closed by said electric eye and the lever 124 is disengaged from the lug 122 by the action of the electromagnet, so that the stop rod nib 114 is brought into the path of the oscillating slay structure 40 and the stopping mechanism is rendered active. The portion of the yarn reserve still left on the bobbin is sufficient to permit the performance of a few more picks after the abutment of the slay beam 52 against the stop rod nib 114. After the stoppage of the loom, the operator may replace the shuttle with the exhausted bobbin by a shuttle with a full bobbin.

Figs. 5 and 6 illustrate the application of my weft protector mechanism to a loom equipped with an automatic shuttle change motion.

According to Figs. 5 and 6, the main shaft 32 carries a tight pulley 34, a first loose pulley 36 and a second loose pulley 232. A pinion 234 secured to the second loose pulley 232 and loosely arranged on the main shaft 32 meshes with a gear 236 keyed to a shaft 238 journaled in a bearing 239 secured to the frame 30 of the loom. Said gear 236 carries the cams 240 and 242 for the actuation of the automatic shuttle change motion proper (not shown in the drawings).

The slay structure 40 pivoted to the frame 30 at 42 is driven by the main shaft 32 through the medium of the crank mechanism 44, 50.

The position of the stop rod nib 114 pivoted to the stopping handle 78 at 116 is controlled by the drop rod 118 locked in its position by the lever 124 forming the armature of the electromagnet 142.

The upper portion of the stopping handle 78 extends through an aperture 244 of a plate 246 mounted on the frame of the loom. During normal operation of the loom, the stopping handle is engaged with a recess 248 of said aperture. One end of a link 250 is pivoted to an arm 252 mounted on the stopping handle 78, the other end of said link 250 is pivotally connected with a lever 254 pivoted to a bracket 256 at 257. The free end of the lever 254 carries the belt shifter 68.

The arrangement of the electro-optical system 134, 136, 138, 140, 142, 148, 150 and of the registering openings 156, 158, 160, 162 is the same as in the embodiment of the loom shown in Figs. 1, 2 and 8. The timing switch 198 arranged in

the circuits of the electro-optical system is actuated by the cam 200 keyed to the picking shaft 64 driven by the gears 60 and 62 meshing with each other.

The operation of the weft protector mechanism is as follows: As soon as the bobbin 132 becomes exhausted and the path of the light beam 164 is unobstructed when the shuttle 66 is in the shuttle box 54, the electric eye 138 closes the circuit of the electromagnet 142, so that the latter is excited and causes a disengagement of the lever 124 from the lug 122 of the drop rod 118. Upon falling down of the drop rod 118 thus released, the stop rod nib 114 is brought into the path of the slay beam 52 as shown in dash and dotted lines in Fig. 5, whereby the automatic shuttle change motion is rendered active. Now, when the slay beam 52 hits the stop rod nib 114 during the next forward movement, the stopping handle 78 is moved in the direction of the arrow B (Fig. 6), so that it is disengaged from the recess 248. Owing to the resiliency inherent to the stopping handle 78, the latter is subsequently moved against the side edge 258 of the aperture 244, whereby the lever 254 is swung about the pivot 257 and the belt shifter 68 moves the belt 38 to come in engagement with the second pulley 232 actuating the automatic shuttle change motion through the medium of the pinion 234 and gear 236. After the performance of one rotation, the gear 236 automatically returns the stopping handle into the recess 248 by a cam and suitable linkage connection (not shown). Thus, the shuttle with the exhausted bobbin is automatically replaced by a shuttle with a full bobbin and the operation of the loom is continued.

It may be mentioned that Figs. 5 and 6 also illustrate means for stopping the loom when the shuttle does not reach the box. For this purpose a bell-crank lever 260 is pivotally mounted on the slay structure at 262. The upper arm of said bell-crank lever 260 is in engagement with the shuttle binder 154. When a shuttle is in the shuttle box, the bell-crank lever 260 is in the position shown in full lines in Fig. 5, so that the lower projecting arm of the bell-crank lever cannot hit an arm 264 pivotally mounted on the frame at 266, when the slay is moved into its forward end position. If, however, the shuttle does not reach the shuttle box, the shuttle binder is in a position extending further inward into the shuttle box and, as the upper arm of the bell-crank lever follows the shuttle binder, the lower arm of said bell-crank lever comes into the position shown in dash and dotted lines. Now, the lower arm of the bell-crank lever hits the arm 264, during the next forward movement of the slay, whereby a hook-shaped member 268 connected to an extension of the arm 264 is swung about the pivot 266 and covers the portion 269 of the aperture 244. At the same time, a lug 270 arranged on the arm 264 abuts against a lug 272 of the stopping handle 78, so that the latter is moved in the direction of the arrow B. Now, the movement of the stopping handle 78 in the oblong portion of the aperture 244 is limited by the edge 274 of the hook 268 covering the portion 269 of the aperture. Therefore, the belt shifter 68 is moved only to such an extent, that the belt 38 comes in engagement with the first loose pulley 36 permitting the stoppage of the loom. As, under these circumstances, the belt 38 is not brought in engagement with the second loose pulley 232, the automatic shuttle change motion is not actuated.

Fig. 7 illustrates the application of my weft protector mechanism to a loom equipped with an automatic weft supply motion or automatic bobbin change motion. Only the electromagnet 142 of my electro-optical system is shown in Fig. 7. The arrangement of the parts of the electro-optical system is substantially the same as that of the parts of the electro-optical system shown in Figs. 1 and 2 with the only exception of the arrangement of the electromagnet 142 at a different place of the frame 30. The lever 124 forming the armature of the electromagnet 142 is in engagement with a lug 276 arranged on a drop rod 278. The upper end of the drop rod 278 is pivotally connected to one end of a weft nib 280 pivoted to one arm of a bell-crank hammer-lever 282. During normal operation of the loom, the lever 124 holds the drop rod 278 and the weft nib 280 in the position shown in full lines in Fig. 7. If, however, the bobbin in the shuttle becomes exhausted, the electro-optical system causes an excitement of the electromagnet 142 as described in connection with the embodiment shown in Figs. 1 and 2, so that the lever 124 is disengaged from the lug 276 and the weft nib 280 is brought into the position shown in dash and dotted lines. Now, the weft nib 280 is in the path of a frog 284 arranged on the slay structure 40, and the frog hits the weft nib during the next backward movement of the slay structure, whereby the hammer 282 is rotated about its pivot 288 for driving a fresh bobbin 288 from the supply support 280 into the shuttle 66 and expelling the exhausted bobbin 132 from the shuttle through an opening 292 at the same time.

Figs. 12 and 13 illustrate the application of my weft protector mechanism to a loom having a box motion. In the embodiment shown in said figures, the movable shuttle box 294 has two compartments 296 and 298. The compartment 296 serves to receive the shuttle 300 with the bobbin 302, and the compartment 298 serves to receive the shuttle 304 with the bobbin 306. A shuttle binder 308 pivoted to the shuttle box 294 at 316 and subjected to the action of a spring 312 cooperates with the shuttle 300, and a similar shuttle binder 314 cooperates with the shuttle 304. A conventional mechanism (not shown) is provided for causing timed automatic shifting movements of the shuttle box 294 relative to the slay 46, so that either the compartment 296 or the compartment 298 is brought into a position permitting the respective shuttle 300 or 304 to move along the slay. According to Fig. 12, the shuttle box 294 is in such a position, that a picker (not shown) extending through a slot 316 of the slay 40 may cooperate with the shuttle 300 for actuating same. The compartment 296, the shuttle 300 and the shuttle binder 308 have openings 318, 322, 322, 324 registering with the slot 316 of the slay when the shuttle box is in the position shown in Fig. 12 and the shuttle 300 is active. The compartment 298, the shuttle 304 and the shuttle binder 314 have openings 326, 328, 330, 332 which may register with the slot 316 of the slay, when the shuttle box is in its elevated position so as to render the shuttle 304 active. The electro-optical system is arranged in such a way, that the light beam 164 may pass through the slot 316, so that the weft protector mechanism is controlled by the yarn of the active shuttle. If desired, however, the electro-optical system could be arranged in such a way, that the light beam may pass through an aperture 334 of the

slay 40 and the openings 326, 328, 330, 332, so that the weft protector mechanism is controlled by the yarn of the inactive shuttle. In the embodiment shown in Fig. 12, the movable shuttle box has only two compartments; my weft protector mechanism, however, could also be applied to looms with a movable shuttle box having more than two compartments. Moreover, my weft protector mechanism may be used in looms with movable shuttle box, in which shuttles without spindles as shown in Fig. 10 or shuttles with tubular cops as shown in Fig. 11 are used. Furthermore, my weft protector mechanism may be applied to looms with a box motion at each side of the slay. Furthermore, it may be pointed out, that the weft protector mechanism applied to a loom having one or more box motions may be utilized to control a stopping mechanism as shown in Figs. 1 and 2 or to control an automatic shuttle change motion as shown in Figs. 5 and 6 or to control an automatic weft supply motion as shown in Fig. 7.

Figs. 14-19 illustrate my protector mechanism in the form of a warp stop motion. As an example, this warp stop motion is shown in combination with a loom of a different type. This loom has a shaft 336 journaled in bearings 338 and 340 mounted on the frame 342. Said shaft 336 carries a loose pulley 344 engaged with a driving belt 346. Furthermore, a clutch 348 is arranged on the shaft 336. One member of said clutch is loosely arranged on the shaft and is connected with said loose pulley 344. The other member of said clutch is keyed to the shaft 336. A lever 350 pivoted to the frame 342 at 352 is pivotally connected with a member 354 slidably arranged on the shaft 336 and associated with one member of the clutch. The lever 350 serves to engage the members of the clutch with each other or to disengage same from each other. Furthermore, a brake drum 356 embraced by a brake band 358 is keyed to the shaft 336. A bevel gear 360 secured to the shaft 336 meshes with a compound gear 362 keyed to the picking shaft 364. Said compound gear 362 in turn meshes with a spur gear 366 keyed to a shaft 368 operatively connected with the slay structure (not shown) by a crank mechanism (not shown). Said shaft 368 also carries an eccentric drive 370 operatively connected with a rod 372 slidably arranged in a bearing 374. Thus, a rotation of the shaft 338 causes a back and forth movement of the rod 372 in the direction of the arrows C and D. An element 376 provided with a hook 378 is adjustably connected to the rod 372 by means of a screw and slot connection 380. Said element 376 forms one member of a coupling. The other member of the coupling consists of an element 382 provided with a hook 384 and pivotally connected with one end of a rod 386 slidably arranged in a bearing 388. The other end of the rod 386 is pivoted to one end of a link 390. The other end of said link 390 is hinged to a rod 392 at 394. Said rod 392 is slidably arranged in a bearing 396. The upper end of the rod 392 extends through an aperture of the breast beam plate 400. A pressure spring 402 arranged between the bearing 396, and a collar 404 secured to the rod 392 tends to urge a lug 406 arranged on the rod 392 against the breast beam plate 400, so that the rod 392 is locked in its position during normal operation of the loom. The rod 392 carries a cam 408 adapted to cooperate with one arm of a double armed lever 410 pivoted to the frame at 412.

Said arm of the lever 410 is connected with a starting handle 414 by a pin and slot connection 416. The starting handle 414 is pivotally mounted on the frame at 418. The other arm of the lever 410 is hinged to one end of a rod 420. The other end of said rod 420 is hinged to the lever 350 actuating the clutch 348. A spring arrangement 422 tends to hold the lever 350 in either one of its end positions for engagement or disengagement of the members of the clutch 348. The lower end of the rod 392 is hinged to the front portion of a foot lever 424 pivoted to the frame at 426 and connected with the brake band 358 by a link 428. As long as, during normal operation of the loom, the members 376 and 382 of the coupling do not come in operative engagement with each other when the rod 372 moves in the direction of the arrow C, the rod 392 remains in its locked position shown in Fig. 14. If, however, as will be described hereinafter, the members 376 and 382 of the coupling come in operative engagement with each other when the rod 372 moves in the direction of the arrow C, the link 390 is drawn in the same direction, so that the lug 406 becomes disengaged from the breast beam plate 400 and the spring 402 moves the rod 392 in upward direction. Thus, the cam 408 swings the lever 410 about its pivot 412, whereby the starting handle 414 comes into the position shown in dash and dotted lines and the lever 350 is rocked about its pivot 352 by means of the rod 420, so that the members of the clutch 348 are disengaged. At the same time, the rod 392 swings the foot lever about the pivot 426, so that the brake band 358 is tightened and the loom is stopped.

As pointed out above, the engagement of the coupling members 376 and 382 during a stroke of the rod 372 in the direction of the arrow C causes a stoppage of the loom, and this engagement is controlled by an electro-optical system in dependence of a change of the arrangement of the warp yarns 428 due to a breakage of one or several warp yarns or to the formation of a float as diagrammatically indicated by 430 in Fig. 19. The electro-optical system includes a light source 432, a photoelectric element or electric eye 434 and an electromagnet 436 mounted on suitable places of the frame 342 and arranged in suitable electric circuits 438. Preferably, the light source 432 and the electric eye 434 are adjustably mounted on the frame. Furthermore, four mirrors 440, 442, 444, 446 are adjustably mounted by means of universal joints 447 on brackets 448 attached to the frame of the loom. The light source, the mirrors and the electric eye are arranged in such a way, that a light beam 450 emanating from the source 432 is directed by the mirror 440 through the open shed 452 near the front corner 454 thereof, whereupon it is reflected by the mirror 442 to the mirror 444, which reflects the beam through the open shed 452 near the rear corner 456 thereof to the mirror 446 directing the beam to the electric eye 434. If the shed is clear, the beam 450 is uninterrupted and the electric circuit of the electromagnet 436 controlled by the electric eye 434 is closed, so that the excited electromagnet holds the member 382 in the elevated position shown in Fig. 14 and prevents an engagement of the members 376 and 382 with each other. If, however, the beam 450 is interrupted by a broken warp yarn or a float 430 in the shed and does not reach the electric eye 434, the circuit of the electromagnet is open and the latter is deener-

gized, so that the member 382 may drop into the position shown in dash and dotted lines in Fig. 17, whereby the members 376 and 382 are engaged with each other during the next stroke of the rod 372 in the direction of the arrow C and the loom is stopped as described above.

In Fig. 18, 458 generally indicates the warp beam, 460 generally indicates the harness, and 462 generally indicates the cloth beam. The harness 460 serves to change the shed at timed intervals in a manner known per se. During the changing of the shed, the shed is closed for a certain time interval, so that the light beam 450 projected from the source 432 is interrupted by the warp yarns at this particular time interval, although no disturbance of the warp yarn arrangement requiring a stoppage of the loom has taken place. As will be described hereinafter, however, the timing means comprising the eccentric drive 370 and the coupling 376, 378, 380, 382 arranged between the electromagnet 436 and the stopping mechanism 392, 420, 350, 348, 424, 356, 358 render the electro-optical system operative only at the intervals when the shed is open, so that the stopping mechanism cannot be actuated by the electro-optical system at the intervals when the shed is closed. Fig. 16 illustrates the member 376 in its right-hand end position, wherein the hook 378 of the member 376 locks the member 382 forming the armature of the electromagnet 436 in its raised position, so that the armature 382 cannot drop, although the electromagnet 436 is deenergized due to an interruption of the light beam by the warp yarns of the closed or substantially closed shed. During the rotation of the shaft 338, the member 376 is moved in the direction of the arrow D. Shortly before the hook 378 becomes disengaged from the hook 384, the shed is opened, and the electromagnet is excited when the shed is clear. If the electromagnet is not strong enough to attract its armature 382, the latter may drop into the position shown in dash and dotted lines in Fig. 17. At this time, however, the stopping mechanism is not actuated, as the member 376 is still moved in the direction of the arrow D. When the member 376 reaches the left-hand end position as shown in Fig. 17, it abuts against the member 382 and lifts same against the electromagnet 436 into the position shown in full lines in Fig. 17. Now, when the shed is clear, the electromagnet is excited and holds the member 382 in the elevated position, so that the hooks 378 and 384 are not engaged with each other and the stopping mechanism is not actuated during the return movement of the member 376 in the direction of the arrow C. The shed is closed or is substantially closed, shortly after the hook 378 of the member 376 has come below the hook 384, so that during the second portion of the return movement of the member 376 the electromagnet is mechanically locked in its position and the electro-optical system is rendered inoperative. Of course, any other timing means could be used to render the electro-optical system operative only at the intervals when the shed is open.

The operation of my warp stop motion is as follows: The mirrors 440, 442, 444, 446, the light source 432 and the electric eye 434 are adjusted in such a way, that the light beam 450 passes through the shed as near as possible to the corners thereof. The nearer the light beam to the corner, the more sensitive the warp stop motion. Furthermore, the member 376 is adjusted relatively to the rod 372 in accordance

with the operation of the shed motion. During normal operation of the loom, the light beam 450 passes through the open shed and the electric eye 434 closes the electric circuit of the electromagnet 436, so that the latter is excited and prevents an operative engagement of the members 376 and 382 of the coupling. As soon as a warp yarn or warp yarns break or a float is formed, the light beam is interrupted by the yarn or float when the shed is open, so that the electric circuit of the electromagnet is interrupted by the electric eye and the member 382 comes in engagement with the member 376 for an actuation of the stopping mechanism during the stroke of the member 376 in the direction of the arrow C.

I have described preferred embodiments of my invention, but it is clear that numerous changes and omissions may be made without departing from the spirit of my invention. For example, my warp stop motion could be applied to a loom of the type shown in Figs. 1-6, or my weft protector mechanism could be applied to a loom of the type shown in Fig. 14. Moreover, my protector mechanism could be applied to looms of different types not shown in the drawings, for example it could be applied to circular looms. Furthermore, my protector mechanism could be combined with any other type of stopping mechanism or automatic change motion. It is understood, however, that the scope of my invention is not limited to the described and illustrated combination of a protector mechanism with a loom, but that the protector mechanism per se also has inventive merits. While in the drawings the arrangement of a coupling between the electromagnet and the stopping mechanism is shown only in the embodiment of a warp stop motion, such a coupling or a different type of a coupling could also be arranged in a weft protector mechanism. Furthermore, the electromagnet of my electro-optical system could be replaced by a solenoid and could be used in combination with different types of means for releasing the stopping mechanism or automatic change motion. Instead of the embodiment of timing means shown in the drawings for rendering operative the electro-optical system at recurring intervals of the operation of the loom, any other suitable timing means could be used. Under certain circumstances the light source and the electric eye may be arranged in such a way that optical means for reflecting the light beam may be omitted. Instead of the mirrors shown in the drawings other optical means, such as prisms or the like, may be used for directing the light beam. If desired, the electro-optical system of the warp stop motion may be arranged in such a way that the light beam passes through the shed only near one corner thereof. Moreover, my new warp stop motion may be used in combination with a conventional warp stop motion having drop wires placed on the warp yarns. Furthermore, my electro-optical system may be used to control the operation of a loom in dependence of changes of the yarn arrangement other than the described weft breakage, warp breakage or formation of a float.

What I claim is:

1. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising

electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the changing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

2. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; optical means in the path of the beam for directing same; said source of light, said optical means, and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the changing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

3. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed near a corner thereof; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the changing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

4. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed near both corners thereof; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the chang-

ing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

5. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means, said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; optical means in the path of the beam for directing same; said source of light, said optical means, and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed near both corners thereof; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the changing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

6. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; means for adjusting the path of the beam; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the changing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

7. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; optical means in the path of the beam for directing same; said source of light, said optical means, and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed near both corners thereof; means for adjusting the path of the beam; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by a warp yarn in its path; and timing means acting in timed relation with the changing of the shed to prevent the photo-electric means from becoming effective when the shed is substantially closed.

8. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-

electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electric means for actuating said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; and timing means acting in timed relation with the changing of the shed for interrupting the electric circuits of the photo-electric means when the shed is substantially closed so as to prevent the photo-electric means from becoming effective when the shed is substantially closed.

9. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism associated with said photo-electric means; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electromagnetic means for actuating said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; said photo-electric means becoming effective to render active said stopping mechanism when the beam is interrupted by warp yarn in its path; locking means for locking said electromagnetic means; and timing means acting in timed relation with the changing of the shed for rendering inactive said locking means when the shed is open so as to render the photo-electric means operative when the shed is open.

10. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism; controlling means associated with the stopping mechanism for rendering same inactive during normal operation of the loom; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element, and electromagnetic means for actuating said controlling means to render active said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; said photo-electric means becoming effective to actuate said controlling means when the beam is interrupted by warp yarn in its path; a coupling arranged between said electromagnetic means and said controlling means; means normally holding the members of the coupling in inoperative disengaged position; and timing means acting in timed relation with the changing of the shed for permitting an operative engagement of the members of said coupling when the shed is open so as to render operative the photo-electric means when the shed is open.

11. In combination with a loom having a shedding motion: a warp and float stop motion: said stop motion comprising photo-electric means for detecting the inside of the open shed; a stopping mechanism; controlling means associated with the stopping mechanism for rendering same inactive during normal operation of the

loom; said photo-electric means comprising electric circuits including a photo-electric element, a source of light arranged to project a beam upon said photo-electric element and electromagnetic means for actuating said controlling means to render active said stopping mechanism; said source of light and said photo-electric element being arranged in such a way as to direct the path of the beam through the open shed; said photo-electric means becoming effective to actuate said controlling means when the beam is interrupted by warp yarn in its path; a coupling comprising a first and a second hook-like member; and an eccentric drive acting in timed relation with the changing of the shed; the first

coupling member being connected to said controlling means and forming the armature of said electromagnetic means; the second coupling being connected to said eccentric drive for the performance of reciprocating movements; the hooks of said coupling members contacting each other in inoperative disengaged position when the shed is closed and permitting an operative engagement of the coupling members when the shed is open so as to render operative the photo-electric means when the shed is open.

12. A loom as claimed in claim 11 comprising an adjustable connection between the second member of the coupling and the eccentric drive.

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