Sept. 28, 1965 J. MÜLLER 3,208,481

APPARATUS FOR MONITORING THE AVAILABLE WEFT THREAD SUPPLY FROM SHUTTLE MEANS IN A LOOM

Filed Nov. 26, 1962 2 Sheets-Sheet 1

Fig. 1

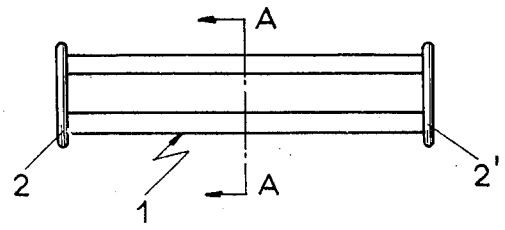


Fig. 2

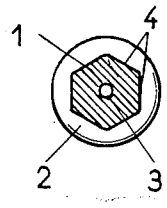


Fig. 3

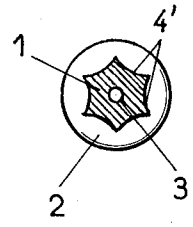


Fig. 4

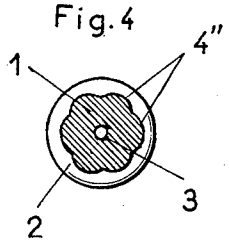


Fig. 5

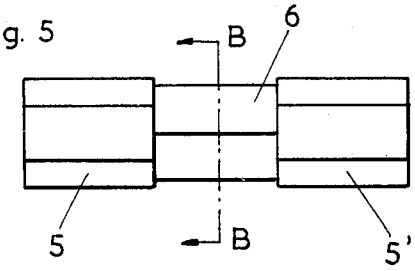


Fig. 6

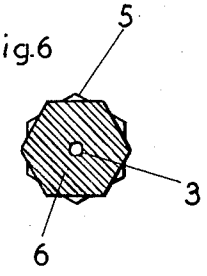
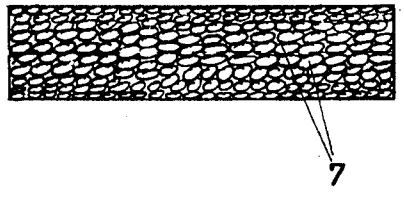


Fig. 7



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APPARATUS FOR MONITORING THE AVAILABLE WEFT THREAD SUPPLY FROM SHUTTLE MEANS IN A LOOM

Filed Nov. 26, 1962 2 Sheets-Sheet 2

Fig.-8

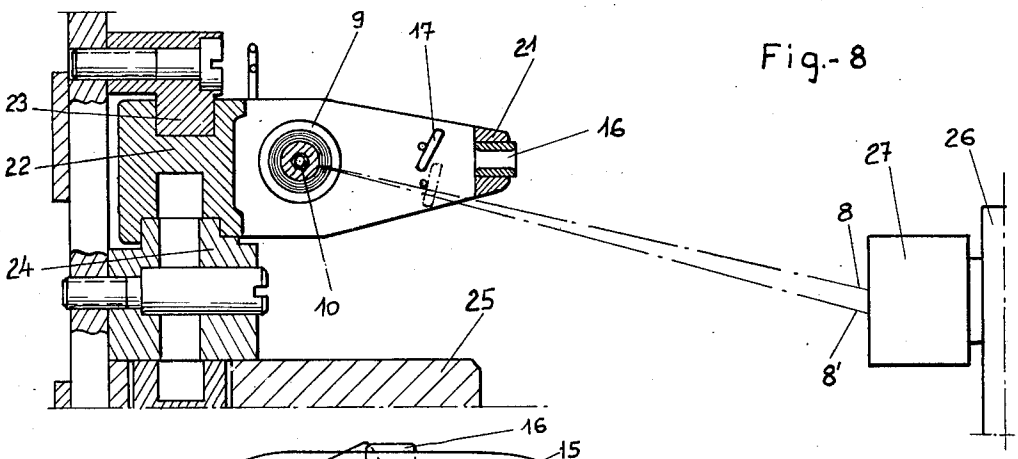


Fig.-9

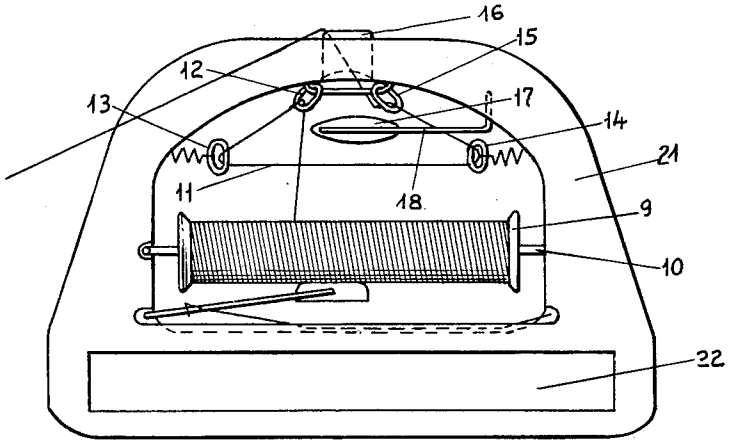


Fig.10a

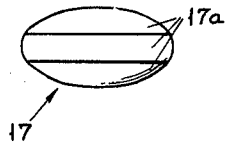


Fig.10b

Fig.11a

Fig.11b

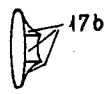


Fig.13a

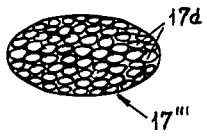


Fig.13b

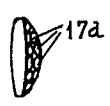
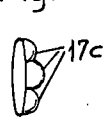


Fig.12a

Fig.12b



Jakob Müller

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3,208,481

APPARATUS FOR MONITORING THE AVAILABLE WEFT THREAD SUPPLY FROM SHUTTLE MEANS IN A LOOM

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Claims priority, application Switzerland, Nov. 27, 1961, 13,792/61
13 Claims. (Cl. 139—273)

The present application refers to textile machinery and more specifically to an apparatus for monitoring the available weft thread supply from shuttle means in a loom, particularly in a ribbon weaving loom.

In the operation of a loom, it is always desirable to monitor the available weft thread supply from the shuttle means of the loom because the available supply of thread may be affected in two ways: first, as the thread is unwound from the spool carried by the shuttle means, the available supply of thread from the spool and therefore from the shuttle means may become exhausted in which case a new spool has to be inserted with a new supply of weft thread; second, the thread which is pulled off the spool may break.

In both cases a monitoring device continuously checking on the available weft thread supply would have to give a signal so that the loom may be stopped and in the first case a new spool with a new supply of thread inserted, while in the second case the ends of the broken thread would have to be tied together. In the first case where a new spool with thread has to be inserted, it is additionally desirable that the monitoring device furnishes a signal somewhat before the available supply of thread on the spool is completely exhausted.

For monitoring the available thread supply in a loom, it is known to use photo-electric means namely a source of light directing a beam of light to a selected area of the loom where ordinarily during operation thread furnished by the thread supply is present, and photo-responsive indicator means exposed to said beam of light when no thread is present in the above mentioned area whereby an indication is obtained that under these circumstances no thread supply is available for opertaion.

Arrangements of this nature have been found as not entirely satisfactory or efficient.

It is therefore one of the objects of this invention to provide for an apparatus for monitoring the available weft thread supply from shuttle means in a loom which is more efficient than conventional devices of similar nature.

It is another object of the invention to provide for an apparatus of the type set forth comprising reflector means of improved efficiency for reflecting the beam of light mentioned above toward the light-responsive indicator means when the available weft thread supply from the shutter means of the loom is reduced to a minimum, which minimum may include zero.

It is still another object of the invention to provide for reflector members of increased efficiency when used in a monitoring arrangement as mentioned above.

With the above objects in view, the invention includes an apparatus for monitoring the available weft thread supply from shuttle means in a loom, particularly in a ribbon weaving loom, comprising, in combination, a stationary source of light projecting a beam of light toward the path of the shuttle means so that during the movements of said shuttle said beam of light impinges in at least one position of said shuttle means along said path on a predetrmined area of said shuttle means where weft thread is normally present during operation; at least one reflecting member arranged to be movable between differently orientated positions on said shuttle means in such a manner that in at least one of said positions of said shuttle means and of said reflecting member said light beam is reflected thereby when the available weft thread supply from said shuttle means is reduced to a predetermined minimum, which minimum may include zero, said reflecting member having at least two distinct reflecting faces, each reflecting in a different particular position of said shuttle means and of said reflecting member rays of light of said beam thereof in a predetermined direction, respectively; and light-responsive indicator means arranged stationarily on the loom in a position for receiving those rays of light which are reflected in a predetermined position of said shuttle means and of said reflecting member in said predetermined direction toward said indicator means, and for furnishing an indication when such rays of light are received so as to indicate thereby that the available weft thread supply from said shuttle means is reduced to said predetermined minimum.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIGS. 1–7 illustrate a weft thread spool shaped in accordance with the invention for being used as a reflector member, FIG. 1 being an elevation of a spool according to the invention and FIGS. 2–4 being cross-sectional end views illustrating three different cross-sectional forms of the spool according to FIG. 1, the section taken along the line A—A of FIG. 1;

FIG. 5 is an elevation of a spool according to the invention showing a modification of the cross-sectional form according to FIG. 2;

FIG. 6 is a cross-sectional end view of the spool according to FIG. 5, the section being taken along the line B—B;

FIG. 7 is a elevtaion of a spool showing a further modification of its reflecting surface;

FIG. 8 is a partly sectional elevation of a conventional monitoring apparatus with a spool and other reflector means which may be modified in accordance with the invention;

FIG. 9 is a plan view of the main portion of the arrangement according to FIG. 8; and

FIGS. 10*a*, 10*b*; 11*a*, 11*b*; 12*a*, 12*b*; and 13*a*, 13*b* illustrate diagrammatically and respectively in front and side views several embodiments of a reflector member according to the invention.

In order to facilitate the understanding of the present invention, the overall arrangement according to FIGS. 8 and 9 will be described first.

In FIGS. 8 and 9 the shuttle **22** of a ribbon weaving loom is shown having a base portion arranged for sliding movement between guides **23** and **24** of a portion **25** of the loom. The shuttle **22** has an arched portion **21** in which a spool **9** may be held as shown by being supported by a rod **10** which is insertable into the shuttle. The weft thread carried by the spool is pulled off the spool and guided through guide rings **12**, **13**, **14** and **15** arranged in a conventional manner as shown in FIG. 9 and from there through a guide sleeve **16** where it leaves the shuttle.

A photo-electric unit **27** of conventional design is mounted stationarily on a portion **26** of the loom and contains a source of light directing a beam of light along line **8** toward the path of the shuttle **22** and more specifically toward the path of the spool **9** carried by the shuttle **22**. The outer surface of the spool **9** is provided with a light reflecting surface so that during operation, when

the innermost layer of thread is at least partly removed from the spool the light beam **8** will be reflected by the reflecting outer surface of the spool **9**, at least in that position of the shuttle in which the reflecting portion of the spool surface is located across the beam **8**, along line **8'** toward a conventional light responsive indicator in the unit **27**. This indicator would indicate in any conventional manner, e.g. by giving an electric signal, that the available supply of weft thread on the spool **9** is reduced to a certain minimum so that thereby the operator is warned to stop the machine and to replace the empty spool by a new spool with a new supply of weft thread.

In order also to monitor the possibility that the available weft thread supply for the loom is reduced to zero because of a break of the thread, a reflector member, e.g. a small mirror **17** carried by a flexible or tiltable wire **18** is so mounted in the arched portion **21** of the shuttle **22** that the wire **18** normally rests on a portion of the thread extended between the guide rings **14** and **15** so as to be held by the tensioned thread in an idle position shown in full lines in FIG. 1 so that the mirror **17** does not extend across the incoming light beam **8** or the reflected light beam **8'**. However, if the thread should break, the tension of the thread between the rings **14** and **15** vanishes and the mirror **17** moves into a second position shown in dotted lines in FIG. 8, namely so as to extend across the beam **8**. The wire **18** forms, therefore, a means preventing the mirror **17** to move from its idle position to its second posiiton, i.e. to a position in which the light beam **8** impinges on the mirror, as long as a thread supply is available, but permitting the mirror to move to the second position if the thread breaks. Under these conditions the beam **8** will be reflected again in the direction of the line **8'** by the mirror **17** so that again the indicator device in the unit **27** would indicate that at this moment there is no weft thread supply available for the loom.

It has been found that the reflection of the incoming beam **8** by the conventional reflector members of the above described arrangement is of comparatively low efficiency. It is to be borne in mind that during operation of the loom, the shuttle is in continuous movement so that the reflecting surface of the reflecting member which may be either the spool surface or the mirror **17** traverses the beam **8** only once with every stroke of the shuttle so that the beam **8** will be reflected in the direction **8'** only for an extremely brief moment. In addition, if the reflecting surface of the spool **9** has the conventional cylindrical shape, the light rays in the beam along line **8** will be reflected by the cylindrical reflecting surface in a diffuse manner and theoretically only one ray which impinges exactly in radial direction on the cylindrical surface will be reflected in the direction **8'**.

This disadvantage is greatly reduced or even entirely eliminated, and the efficiency of the photo-electric system greatly improved if, according to the invention, the reflecting member in the shuttle is constructed to have at least two distinct reflecting faces, each reflecting in a different particular position of said shuttle means and of the reflecting member rays of light of the incoming beam in a predetermined direction, respectively, namely in the direction of the line **8'**.

Referring now to FIGS. 1–7, a reflecting member is illustrated which constitutes or is constituted by the above mentioned weft thread spool.

In FIG. 1 the spool **1** is provided with end flanges **2** and **2'** and with an axial bore **3** adapted to receive the above mentioned support rod or axle **10**.

As shown by FIGS. 2–4, the body of the spool **1** has a cross section providing along the circumference of the spool **1** at least two distinct reflecting faces. According to FIG. 2, the cross-section of the spool body is hexagonal so that in circumferential direction six distinct plane reflecting faces **4** are provided. As the shuttle moves and as the spool **1** turns during operation of the loom, there is bound to occur in intervals a position of the shuttle and an angularly orientated position of the spool in which the beam of light **8** impinges on one of the faces **4** and is fully reflected without diffusion in the direction of the line **8'** toward the unit **27**.

In the modification of FIG. 3, the individual distinct reflecting faces **4'** of the spool are concave so that in addition to the above described effect, the rays of light impinging on a face **4'** are concentrated upon their reflection toward the line **8'** whereby the intensity of the reflected beam upon arrival at the unit **27** is increased.

The concave shape of the faces **4'** may be cylindrical, elliptical, or hyperbolical with similar effect.

According to FIG. 4, the individual faces **4''** of the spool may also be made convex. In this case a concentrated reflection of the beam **8** occurs when the latter impinges on that area of the reflecting surface of the spool where two adjoining convex faces **4''** meet since this area constitutes a groove with inclined lateral portions which act similarly as the concave faces **4'**.

The efficiency of the reflection of light by the surface of a spool as described above can be increased still more if, according to FIGS. 5 and 6, the body of the spool is formed not as a straight prism with cross-sections, e.g. according to FIGS. 2–4, but is subdivided into portions **5**, **5'** and **6**, each having one of the above described cross-sections, the center portion **6** being however angularly offset against the portions **5** and **5'** by 30° in the particular case where the cross-section is essentially a hexagon.

The reflecting effect of the spool surface can be still further increased by greatly increasing the number of distinct reflecting faces thereof. By way of example, FIG. 7 illustrates the outer surface of a spool showing a reflecting surface composed of a great number of small facets **7** which can be produced for instance by the well known hammering process. However, it is to be understood that also in this case the individual facets may be either plane, concave or convex. The relative position of the individual facets with respect to the neighboring facets can be chosen in any desirable manner, and between the individual facets there may be left surface portions which are not light reflecting.

Referring once more to FIGS. 5 and 6, it should be understood that the characteristic arrangement illustrated thereby may be further modified in such a manner that the polygonal cross-sections of the portions **5**, **5'** and **6** may differ from each other. For instance, one portion may have hexagonal and another portion may have octagonal cross-section. Of course, the number of distinct faces following each other in circumferential direction at any cross-section of the spool may be varied as desired. Also the cross-section according to FIG. 4 may be so modified that, for instance, three convex faces **4''** are combined with three concave faces **4'** respectively arranged between the convex faces.

The above described principle of the invention consisting in providing in a reflecting member at least two distinct reflecting faces can be applied in a manner similar to that described above also in a reflecting member as in mirror **17** in FIGS. 8 and 9. Therefore FIGS. 10–13 illustrate by way of example such embodiments of the invention wherein the mirror **17** is provided with at least two distinct reflecting faces analogous to those described above in reference to FIGS. 2, 3, 4 and 7. Thus, FIGS. 10*a*, and 10*b* show respectively in a front view and a side view a mirror **17** having three angularly displaced reflecting faces **17***a* which are substantially plane. FIGS. 11*a*, and 11*b* illustrate a mirror **17'** in which the reflecting faces **17***b* are concavely curved, whereas the reflecting faces **17***c* of the mirror **17''** illustrated in the FIGS. 12, and 12*b* are convexly curved. Finally, FIGS. 13*a* and 13*b* illustrate a mirror **17'''** which has a reflecting surface composed of a great number of small facets **17***d* which can be produced for instance by the well known hammering process. The individual facets **17***d* of the mirror **17'''** may be either plane, concave or convex.

The reflecting member or a multitude of it may also be transparent, so that the beam of light can be reflected by its inner faces as well as by the outer ones, in a way of refraction of light inside the body of the reflecting member.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of apparatus for monitoring the available weft thread supply from shuttle means in a loom differing from the types described above.

While the invention has been illustrated and described as embodied in apparatus for monitoring the available weft thread supply from shuttle means in a loom including at least one reflecting member having at least two distinct reflecting faces, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A thread monitoring apparatus for indicating interruption of a weft thread supply from a spool in a shuttle means of a loom comprising, a stationary source of light projecting a beam of light toward a path along which the shuttle means moves so that during the movements of said shuttle means said beam of light impinges, in at least one of the various positions of said shuttle means along said path, on a predetermined area of said shuttle means where weft thread is normally present during operation; at least two reflecting means arranged to be movable relative to the shuttle means between different positions in such a manner that, while said shuttle means is in at least one of said positions thereof, said light beam is reflected in a predetermined direction by one of said reflecting means in at least one position thereof provided that the weft thread supply available on said spool is reduced to a predetermined minimum and that in one of the positions of the other one of said reflecting means said light beam is reflected thereby also in said predetermined direction when supply of weft thread from said spool is interrupted by a break of the thread, said one reflecting means forming part of said spool and comprising at least two distinct reflecting surfaces thereof, each reflecting in a different particular position of said shuttle means and of said spool thereon, respectively, said beam of light nevertheless in substantially the same predetermined direction, said other reflecting means having a portion with at least one reflecting surface and including means for preventing said portion from assuming said one position as long as the thread supply from said spool is available, but permitting said portion to move to said one position upon a break of said thread; and light responsive indicator means arranged stationarily in a position for receiving rays of light which are reflected by either one of said reflecting means in said predetermined direction, and for furnishing, when such rays of light are received, an indication that weft thread supply from said shuttle means is not available.

2. An apparatus as claimed in claim 1, wherein at least one of said reflecting surfaces is substantially plane.

3. An apparatus as claimed in claim 1, wherein at least one of said reflecting surfaces is concave.

4. An apparatus as claimed in claim 1, wherein at least one of said reflecting surfaces is convex.

5. An apparatus as claimed in claim 1, wherein said one reflecting means is formed at least partly as a polygonal prism the sides of which constitute said distinct reflecting surfaces.

6. An apparatus as claimed in claim 5, wherein said one reflecting means is composed of at least two portions of said spool, each formed as a polygonal prism and coaxial with the other portion, one portion being angularly offset against the other relative to the common axis thereof.

7. An apparatus as claimed in claim 6, wherein at least one of said distinct reflecting surfaces is concave.

8. An apparatus as claimed in claim 6, wherein at least one of said distinct reflecting surfaces is convex.

9. An apparatus as claimed in claim 1, wherein a plurality of said reflecting surfaces is constituted by a plurality of facets.

10. An apparatus as claimed in claim 9, wherein said facets are convex and constitute a hammered pattern.

11. An apparatus as claimed in claim 9, wherein said facets are concave and constitute a hammered pattern.

12. A thread monitoring apparatus for indicating interruption of a weft thread supply from a spool in a shuttle means of a loom comprising, in combination, a stationary source of light projecting a beam of light toward a path along which the shuttle means moves so that during the movements of said shuttle means said beam of light impinges, in at least one of the various positions of said shuttle means along said path, on a predetermined area of said shuttle means where weft thread is normally present during operation; at least two reflecting means, one thereof forming part of the spool and comprising at least two distinct reflecting surfaces normally covered by a thread supply present on said spool and reflecting in certain positions of said shuttle means said beam of light in a predetermined direction when the available thread supply on the spool of said shuttle means is reduced to a predetermined minimum and a second one of said reflecting means being movable between an idle position and a second position in which at certain positions of said shuttle means said light beam is reflected thereby also in said predetermined direction, said second reflecting means including means permitting the same to assume said second position only when the thread supply from said spool is interrupted by a break of said thread; and light responsive indicator means arranged stationarily in a position for receiving rays of light which are reflected by either one of said reflecting means in said predetermined direction, and for furnishing, when such rays of light are received, an indication that weft thread supply from said shuttle means is not available.

13. A thread monitoring apparatus for indicating interruption of a weft thread supply from a spool in a shuttle means of a loom comprising, a stationary source of light projecting a beam of light toward a path along which the shuttle means moves so that during the movements of said shuttle means said beam of light impinges, in at least one of the various positions of said shuttle means along said path, on a predetermined area of said shuttle means where weft thread is normally present during operation; at least two reflecting means arranged to be movable relative to the shuttle means between different positions in such a manner that, while said shuttle means is in at least one of said positions thereof, said light beam is reflected in a predetermined direction by one of said reflecting means in at least one position thereof provided that the weft thread supply available on said spool is reduced to a predetermined minimum and that in one of the positions of the other one of said reflecting means said light beam is reflected thereby also in said predetermined direction when supply of weft thread from said spool is interrupted by a break of the thread, said one reflecting means forming part of said spool and comprising at least two distinct reflecting surfaces thereof, each reflecting in a different particular position of said shuttle means and of said spool thereon, respectively, said beam of light nevertheless in substantially the same predeter-

mined direction, said other reflecting means having a portion with at least two distinct reflecting surfaces and including means for preventing said portion from assuming said one position as long as a thread supply from said spool is available, but permitting said portion to move to said one position upon a break of said thread; and light responsive indicator means arranged stationarily in a position for receiving rays of light which are reflected by either one of said reflecting means in said predetermined direction, and for furnishing, when such rays of light are received, an indication that weft thread supply from said shuttle means is not available.

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