June 17, 1958 C. O. MEINERS ET AL 2,839,669

THREAD ILLUMINATOR

Filed Oct. 11, 1954 3 Sheets-Sheet 1

Fig. 1.

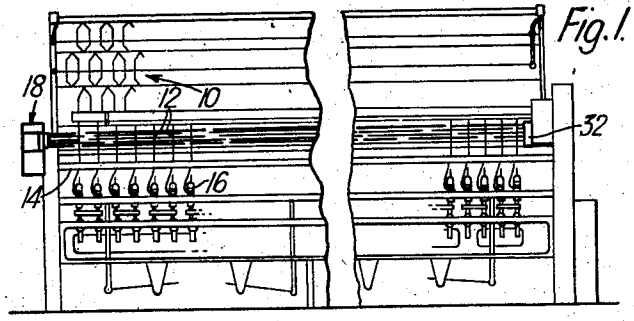


Fig. 2.

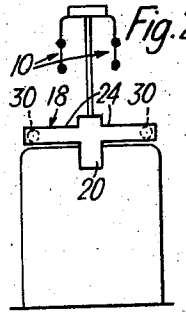


Fig. 3.

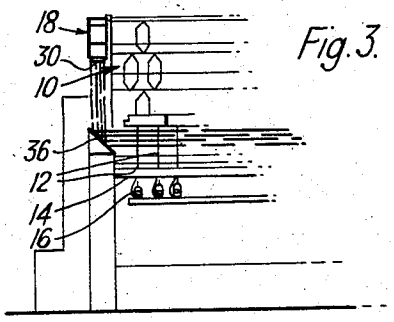


Fig. 4.

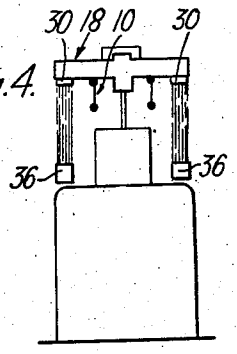
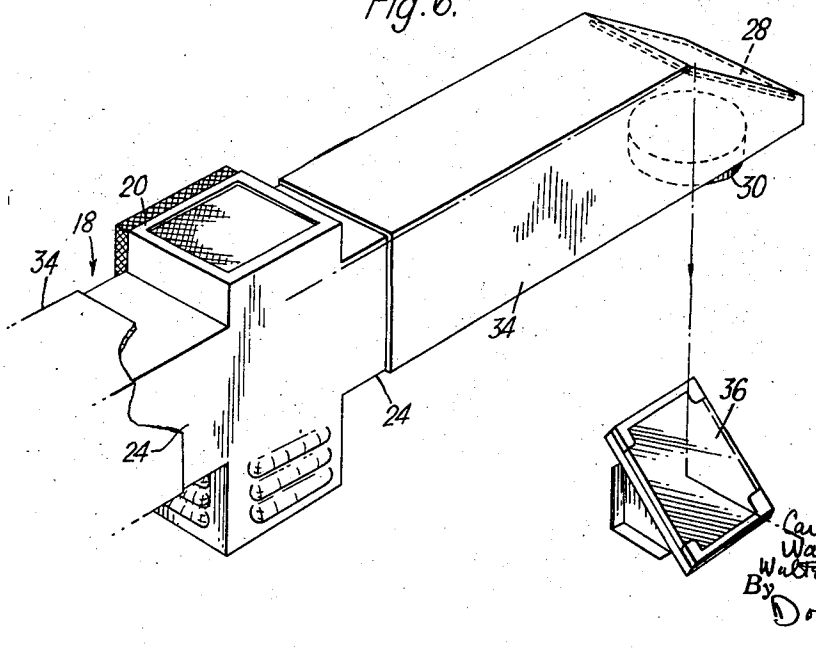


Fig. 6.



Inventors
Carl Otto Meiners
Walter Lessing
Walter Benno Lessing
By Dowell & Dowell
Attorneys

June 17, 1958 C. O. MEINERS ET AL 2,839,669

THREAD ILLUMINATOR

Filed Oct. 11, 1954 3 Sheets-Sheet 2

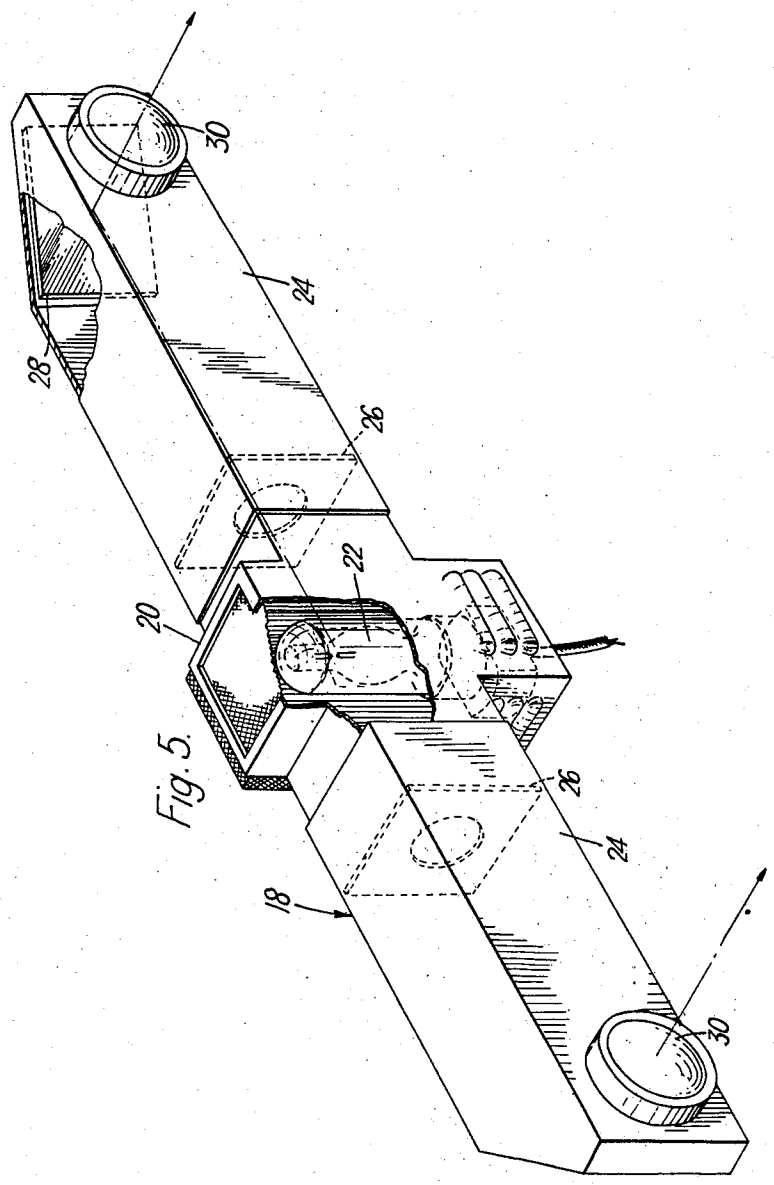


Fig. 5.

Inventors
Carl Otto Meiners
Walter Lessing
Walter Benno Dessing
By
Donald H. Dowell
Attorneys

June 17, 1958 C. O. MEINERS ET AL 2,839,669

THREAD ILLUMINATOR

Filed Oct. 11, 1954 3 Sheets-Sheet 3

Fig. 7.

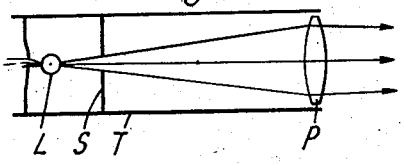


Fig. 10.

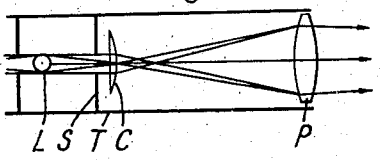


Fig. 8.

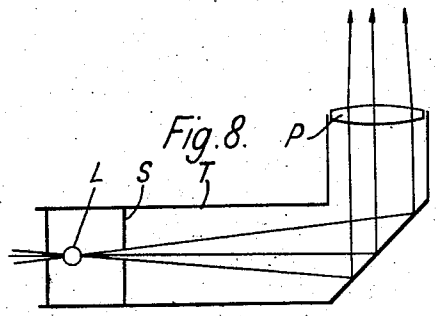


Fig. 11.

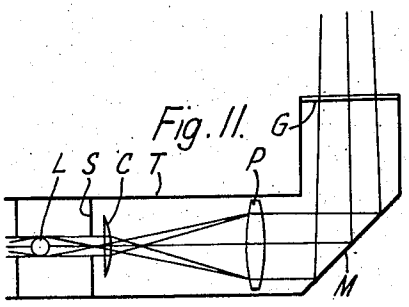


Fig. 9.

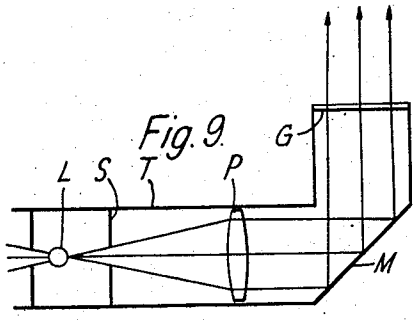


Fig. 13.

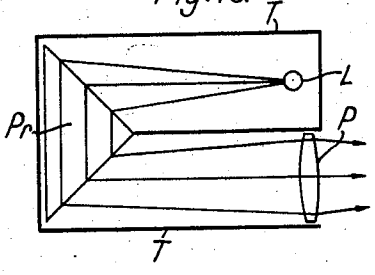
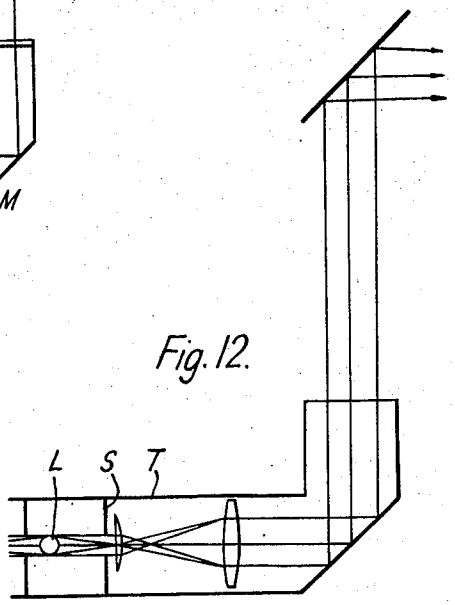


Fig. 12.



Inventors
Carl Otto Meiners
Walter Lessing
By Benno Lessing
Dowell & Dowell
Attorneys

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THREAD ILLUMINATOR

Carl Otto Meiners, Oldenburg, Germany, and Walter Lessing and Walter Benno Lessing, London, England, assignors to Meiners Optical Devices Limited, London, England

Application October 11, 1954, Serial No. 461,318

Claims priority, application Great Britain October 15, 1953

4 Claims. (Cl. 240—2)

This invention relates to thread illuminators for use on spinning and certain other textile machines.

In the ring spinning frames used in the cotton and worsted industries, the threads run down from drawing rollers to and through a thread guide and then to the spindle.

Above the thread guide, the threads are very difficult to detect. This is particularly the case with fine counts and with coloured or dark threads.

Below the thread guide, the threads are whirled at high speed or "ballooned" and they become still more difficult to detect.

In cap spinning frames and in rayon twisting machines where there is no thread guide, the threads are whirled from the delivery rollers to the spindle and the same difficulty of detection arises.

Consequently, breaks are not rapidly detected and loss of production results.

Improvement in the lighting of the spinning room does not lead to any improvement at all. Attempts have therefore been made to direct light on to the threads themselves and also to improve the background against which the yarns or threads are viewed but these have not provided solutions which have been acceptable to the spinner.

The thread illuminating devices which have so far been offered to the spinnner have been based on the use of reflectors and of electric filament lamps.

The textile machines in question are of substantial length; 20–30 feet is common and 50 feet is not unusual. The use of a projector has not proved a satisfactory solution because the intensity of the beam which it projects decreases rapidly along the length of the beam. In practice, it is not possible to ensure the production of a parallel beam. The beam produced by a projector is a cone which increases in diameter as the distance from the projector increases, with the consequence that parts of the machine are illuminated in addition to the threads. Furthermore, projectors involve reflectors which unavoidably lead to the operator being dazzled and from which there is much stray reflection. Finally, reflecting projectors are bulky and cannot be easily fitted to the machines.

Electric filament lamps have been found unsatisfactory in themselves in that they illuminate the threads neither sufficiently strongly nor sufficiently sharply, that is to say, they lead to a degree of illumination which is inadequate both absolutely and relatively to the illumination of neighbouring parts of the machine.

The absolute degree of illumination is dependent on the power of the lamp but increasing that power to the limit of what can be achieved with a filament lamp has not produced any material improvement.

The relative degree of illumination depends on the ability to illuminate the threads without illuminating near objects which, in practice, means that the illuminating beam must be of small cross section and give rise to a minimum amount of dispersion. That consideration leads to the use of small sources of light approximating

to optically perfect point sources. A point source of light, however, is not a practical proposition.

We have come to the conclusion that there is a third factor which must be taken into consideration and which is even more important than intensity of illumination, either absolute or relative, namely, the quality of the illumination.

The yarn illuminator in accordance with the invention comprises a source of light having a brightness of at least 2,000 stilb (2,000 candles per sq. cm.) and emitting short waves not extending substantially outside the blue and blue-green ranges of the spectrum, which is used in conjunction with an optical system which projects along the machine an image of the light source as distinct from collecting light from the source and projecting it by reflecting in the form of a beam.

A brightness well in excess of 2,000 stilb being desirable, it is unlikely that a filament lamp could be successfully used as the source of light. Furthermore, the filament lamps available today, even if of the required brightness, would not give the desired result, because the quality of the light which such a lamp emits does not cause textile threads moving at high speed to be brought into relief to the degree necessary for them to be individually detected by the eye. The required brightness and quality are obtainable from a mercury vapour discharge lamp. The beam projected from the discharge lamp must not be dispersed. The tolerance in this respect is almost negligible as even a small amount of dispersion may defeat the object of the illuminator. Best results are obtained if the lamp is used in conjunction with an optical system which projects along the length of the frame, a convergent beam coming to a focus at a distance from the source not shorter than half the length of the frame. As the textile frames with which the invention is concerned can have a length of the order of 50 feet or more, the point of convergence of the beam should be at least 25 feet from the source.

In the earlier proposals using filament lamps, parallelism of the beam has been sought which, in general, involves the use of a point source of light. A convergent beam, however, allows a source of substantial dimensions to be used and, therefore, stray illumination of neighbouring objects can be avoided without sacrificing intensity of illumination. Also, the intensity of illumination being so high when a discharge lamp is used, no disadvantage accrues from the smaller area of illumination of the yarn resulting from convergence of the beam. A convergent beam cannot be obtained with a reflecting projector.

The convergence of the beam can be very slight. It can, indeed, be such that over the length of the frame, the beam is, to all intents and purposes, parallel.

The high intensity of the source of light also has the advantage that the lenses and other optical elements of the optical system do not have to be of remarkably good quality and, therefore, need not be particularly expensive.

One source of light can, if desired, be used for the illumination of the yarns on both sides of a double-sided textile frame, through separate optical systems. As lamps having the required characteristics are rather expensive, that expedient will generally be resorted to. Indeed, where, as is not infrequently the case in twisting machines, there are four rows of spindles, a single discharge lamp can be used for the illumination of the threads going to all four rows.

An example of the application of the invention to the illumination of the threads in a ring spinning frame and some examples of suitable optical systems are shown in the accompanying drawings in which:

Figure 1 is a diagrammatic front elevation of the machine fitted with the illuminator;

Figure 2 is a diagrammatic end view of Figure 1;

Figures 3 and 4 correspond to Figures 1 and 2 and illustrate a different manner of mounting the illuminator;

Figure 5 is a perspective view of the illuminator;

Figure 6 is a similar view illustrating the use of the illuminator when it is mounted as in Figure 3, and

Figures 7–13 show a number of different optical systems.

The machine shown in Figures 1–4 is a conventional ring spinning frame having a creel **10**. The threads **12** pass down through a thread guide **14** below which they are whirled or "ballooned" as they are laid on the bobbins **16**. The frame is double sided as indicated in Figures 2 and 4.

On one end of the frame is mounted the illuminator **18** which is shown separately in Figure 5.

The illuminator consists of a casing providing a central housing **20** for a lamp **22** and two oppositely directed trunks **24**. Within each trunk, there is an apertured plate **26** forming an optical stop and a plane mirror **28** which is set at 45° to the longitudinal axis of the trunk. In one face of each trunk, there is a lens **30** which collects the light reflected by the mirror **28**.

The illuminator is mounted on the machine so that the lenses **30** project light from the lamp **22** across the threads as they pass down to the thread guide **14**.

The lamp **22** is a mercury vapour lamp. Such lamps can have a brightness of the order of 8,000 to 10,000 stilb. The greater the brightness, the better the result, but the shorter is the life of the lamp. In general, a brightness as high as 8,000 stilb is not necessary.

The optical system is that shown in Figure 8 which will be explained in due course. At the moment, it is sufficient to say that it projects along each side of the frame through the lenses **30**, slightly convergent beams which may, if desired, be reflected backwards by non-dazzle mirrors **32**.

The brightness and quality of the light emitted by the lamp are such that the threads **12** are thrown up in relief and can be easily watched individually.

If, as is sometimes the case, it is not convenient to mount the illuminator at the end of the frame as shown in Figures 1 and 2, it may be mounted above the end as shown in Figures 3 and 4. With that in view, the ends **34** which carry the mirrors **28** and lenses **30** are mounted to slide on and off the trunks **24**. The latter are of square cross-section so that the ends **34** can be mounted, as shown in Figure 6, so that the beam from the lamp is reflected downwards instead of horizontally. It remains then, only to provide a pair of mirrors **36** to reflect the downward emergent beams horizontally along the frame as shown in Figure 3.

The optical systems shown in Figures 7–12 have as common features a tube T which corresponds to one of the trunks **24**; a lamp L which corresponds to the lamp **22**; a bi-convex projecting lens P which corresponds to one of the lenses **30**; and (except in Figure 13) a stop S which corresponds to one of the apertured plates **26** through which a divergent beam passes to the lens. In all cases, at any point along the optical path, one can obtain an image of the source of light.

In Figure 7, the lens P receives from the lamp a divergent beam through the aperture in the stop S and transmits it as a slightly convergent beam.

In Figure 8, the incident beam is reflected by a mirror M before being received by the lens P, the finally emergent beam being at right angles to the incident beam passing through the stop. This is the system used in the illuminator shown in Figure 5. By duplicating the arrangement on the other side of the lamp L, two emergent beams parallel to each other can be provided as shown in Figures 1 and 2.

An alternative to Figure 8 is shown in Figure 9. In this case, the lens P receives the incident beam directly and the emergent beam is reflected by a mirror M. The end of the tube is closed by a glass plate G which forms no part of the optical system.

Figures 10 and 11 show arrangements similar to those of Figures 7 and 9 respectively except that they each include a collector lens C immediately beyond the stop S.

The emergent beam can, if desired, be reflected outside the tube T as, for example, by the mirror M shown in Figure 12.

In order to shorten the tube T, the incident beam may, as shown in Figure 13, be reflected parallel to itself by a prism Pr.

A plano-convex collector lens such as the lens C shown in Figures 10 and 11 may produce an excessive magnification of the light source. In that case, it can be replaced by a bi-convex lens.

In all cases the lens P is designed to produce a convergent emergent beam the point of convergence of which is at least half way along the length of the frame so that, at the far end of the frame, it will not have diverged to greater dimensions than it had on leaving the lens. As already explained, a beam of restricted dimensions becomes acceptable because of the high degree of brightness of the source and has the advantage of illuminating substantially only the parts to be illuminated, viz: the yarns.

Textile yarns and rovings differ very much in colour, lustre and reflective power. It is only by using the blue and blue-green range of the spectrum that one can be sure of so illuminating the threads that they become readily visible. The mercury vapour discharge lamp of a brightness of not less than 2,000 stilb answers all these requirements. Although the first cost of such a lamp is rather high in comparison with that of an incandescent lamp, it has the advantage of having a long life.

The invention is, of course, not restricted to mercury vapour lamps. Any other lamp having the required brightness and giving light in the appropriate range of the spectrum can be used.

We claim:

1. In a textile machine having a double-sided machine frame, thread guides and bobbins mounted on both sides of the frame, threads running from said guides to said bobbins, the said threads being arranged in two substantially parallel rows extending lengthwise of the frame one on each side thereof, an illuminator mounted on the frame so as to project two beams of light of similar characteristics along the length of the frame in parallel paths and thus illuminate the said rows of threads, the illuminator comprising a housing, a source of light in said housing having a brightness of at least substantially 2,000 stilb and emitting short wave rays not extending substantially beyond the blue and blue-green range of the spectrum, two outlets in the housing for the said beams, and two optical systems in the housing each located beneath the source and one of the outlets and each for projecting one of the beams along the length of the frame in the path of one row of threads, each optical system being such that each said beam converges to a focus at a distance from the source not shorter than half the length of the frame, each optical system including a collector lens between the source and the respective outlet in the housing, whereby a comparatively lower stilb-value source can be used provided that the brightness at each said outlet is not substantially less than 2,000 stilb.

2. In a textile machine having a double-sided machine frame, thread guides and bobbins mounted on both sides of the frame, threads running from said guides to said bobbins, the said threads being arranged in two substantially parallel rows extending lengthwise of the frame one on each side thereof, an illuminator mounted on the frame so as to project two beams of light of similar characteristics along the length of the frame in parallel paths

and thus illuminate the said rows of threads, the illuminator comprising a housing, a source of light in said housing having a brightness of at least substantially 2,000 stilb and emitting short wave rays not extending substantially beyond the blue and blue-green range of the spectrum, two outlets in the housing for the said beams, and two optical systems in the housing each located beneath the source and one of the outlets and each for projecting one of the beams along the length of the frame in the path of one row of threads, each optical system being such that each said beam converges to a focus at a distance from the source not shorter than half the length of the frame, the illuminator comprising a lamp compartment in said housing, a mercury vapour lamp in said lamp compartment, a pair of open-ended trunks extending in opposite directions from the lamp compartment an optical stop and a collector lens located intermediate the ends of each trunk, a mirror arranged in each trunk and set to reflect the said short-wave rays from the lamp through 90°, and two biconvex lenses each having its optical axis in the direction of the rays reflected by one of the mirrors for projecting one said beam.

3. In a textile machine, the improvements according to claim 2, in which each mirror and associated biconvex lens are mounted in a part of which the orientation is variable to enable the direction of the emergent beams to be adjusted.

4. In a textile machine having a double-sided machine frame, thread guides and bobbins mounted on both sides of the frame, threads running from said guides to said bobbins, the said threads being arranged in two substantially parallel rows extending lengthwise of the frame one on each side thereof, illuminator means mounted on

the frame so as to project two beams of light of similar characteristics along the length of the frame in parallel paths and thus illuminate the said rows of threads, the illuminator means comprising a housing, a source of light in said housing having a brightness of at least substantially 2,000 stilb and emitting short wave rays not extending substantially beyond the blue and blue/green range of the spectrum, an outlet in the housing for the said beam, an optical system in the housing located between the source and the outlet for projecting a beam along the length of the frame in the path of one row of threads, said optical system being such that said beam converges to a focus at a distance from the source not shorter than half the length of the frame; said illuminator means comprising a lamp compartment in said housing, a mercury vapour lamp in said lamp compartment, an open-ended trunk extending from the lamp compartment, an optical stop and a collector lens located intermediate the ends of the trunk, a mirror arranged in said trunk and set to reflect the said short-wave rays from the lamp through 90°, and a biconvex lens having its optical axis in the direction of the rays reflected by the mirror for projecting the beam.

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