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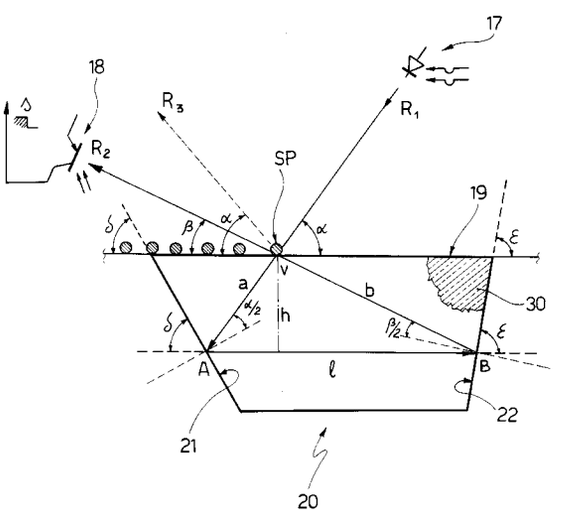
(54) Weft detecting optical device, and weft feeder including said device.

(57) The device comprises an emitter diode (17) and a receiver phototransistor (18) which are arranged at the same face of a transparent plate (19) associated with the drum (11) of the weft feeder (10) and suitable to receive the turns of the weft reserve (RF). The emitter (17) directs onto the transparent plate (19) a beam of rays (R_1) which is tilted at a preset angle of incidence (α), and the receiver (18) receives a beam of rays (R_2) that emerge from the transparent plate (19) and form an angle of reflection (β), with respect to the plate, which is different from the angle of incidence (α) produced by multiple-reflection means (20) located at the other face of the transparent plate (19). The incident rays (R_1) and/or the emerging rays (R_2) are interrupted by a turn (SP) of the reserve of thread (RF) when the turn reaches the plate (19), so as to screen the receiver (18) from the light; the receiver emits a corresponding turn presence signal (s).

FIG. 3



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The present invention relates to a weft detecting optical device, particularly for detecting the presence of a reserve of weft and/or the breakage of the weft on weft feeders for looms and textile machines in general, and to a weft feeder including said device.

As it is known, weft feeders are units that have a fixed drum on which a rotating arm winds a plurality of turns of thread that form a reserve of weft. The reserve turns unwind from the drum on demand of the loom or textile machine, and before the reserve is depleted said rotating arm winds other turns so as to constantly supply the reserve of turns; a series of rods that move in a wavelike manner causes the axial advancement of the turns fed from the base toward the head of the drum of the unit.

A detection device, which is sensitive to the presence of the reserve turns of the thread, activates the rotating arm when the number of said turns of the reserve drops below a preset limit.

Devices for detecting the presence of the turns of reserve thread, based on the use of one or more light ray emitting devices, generally constituted by photodiodes, and of one or more receivers for said light rays, generally constituted by phototransistors, are already known.

There are essentially two known methods for using said light emitters and receivers.

A first method consists in detecting, by means of the phototransistor, or receiver, the change produced by the interference of the thread in the light rays that are emitted by the photodiode and reflected by a mirror on top of which the turns of thread are arranged.

A second known method consists in detecting the light rays that are reflected by said thread and emitted by said photodiode.

Both of these known detection methods and the devices to perform them have severe drawbacks that make these devices unreliable.

In the first case, especially in the presence of shiny or low-count threads, the change in the reflected light rays produced by the interference of the thread is in fact very small and hard to detect, with the result that the useful signal emitted by the phototransistor is uncertain, very weak and often lower than the evaluation limit with respect to the "noise" threshold corresponding to the ambient lighting.

The greatest drawback of the second known detection method resides in that the light reflection index is highly affected by the color and count of the thread and this circumstance causes considerable problems in the calibration, which must be changed each time according to the characteristics of the thread being processed. Furthermore, the signal emitted by the phototransistor is greatly affected by the level of the ambient light in this case as well.

A principal aim of the present invention is essentially to eliminate these severe drawbacks, and within the scope of this general aim, another important object of the invention is to provide an optical device for detecting the presence of reserve turns of weft as specified that is capable of providing a signal of substantial amplitude which is independent of the color, count and kind of the thread being processed.

A particular and important object of the present invention is to obtain a device that can provide a signal that has a substantially constant value and is independent of the presence and intensity of the ambient light.

Another object of the invention is to provide a device which is structurally simple, has limited dimensions and is reliable in operation.

With this aim, these important objects and others in view, which will become apparent from the following detailed description, there is provided, according to the present invention, an optical device for detecting the presence of a reserve of weft and/or the breakage of the weft, characterized in that it comprises an emitter diode and a phototransistor which are arranged at the same face of a transparent plate which is associated with the drum of the weft feeder and on which the turns of the weft reserve rest; in that the emitter directs onto the transparent plate a beam of incident rays which is tilted at a preset angle of incidence with respect to said plate; and in that the phototransistor receives a beam of rays that emerge from said transparent plate at an angle of reflection, with respect to said plate, which is different from the angle of incidence produced by multiple-reflection means located at the other face of the transparent plate; and in that the incident and/or emerging rays are interrupted by a turn of the reserve of thread when said turn reaches the plate, so as to screen the receiver from the light, said receiver emitting a corresponding turn presence signal.

According to an embodiment of the invention, the multiple-reflection means include a pair of opposite reflecting surfaces which are mutually orientated so that the beam of incident rays and the beam of emerging rays mutually intersect at a point lying on the surface plane of the transparent plate, so that when a turn of weft is located at said intersection point it interrupts both said incident rays beam and said emerging rays beam, thus screening the phototransistor from the light.

Further characteristics and advantages of the invention will become apparent from the following detailed description and with reference to the accompanying drawings, given by way of non-limitative example, wherein:

figure 1 is an elevation view of a weft feeder with the optical device according to the invention;

figure 2 is an enlarged-scale view of a detail of figure 1;

figure 3 is a schematic detailed view of the reflecting means of said optical device;

figure 4 is a detail view, similar to figure 2, illustrating a variation in application;

figures 5 and 6 are schematic views, similar to figure 3, illustrating a different embodiment of the invention.

In figure 1, the reference numeral 10 generally designates the weft feeder, which includes a fixed drum 11 on which a hollow rotating arm 12, rigidly coupled to a driving shaft 13 which is also hollow, winds a plurality of turns of thread F that forms a thread reserve RF.

On demand of the loom or other textile machine, the thread unwinds from the drum and passes, in a known manner, through a braking means 14 and a thread guiding eyelet 15. The thread reserve is constantly compensated by the arm 12 which is activated by a turn presence sensor S and winds new turns of thread onto the drum 11 when the reserve drops below a preset number of turns. A series of rods 16 that move in a wavelike manner produces, in a known manner, the axial advancement of the turns fed by the arm 12, by moving them from the base toward the head of the drum 11.

According to the invention, the turn presence sensor S includes a photodiode 17 and a phototransistor 18, or other equivalent emitter and receiver means, which are arranged at the same face of a plate of transparent material 19 which is provided on the drum 11 and on which the turns of the thread reserve RF rest.

The photodiode 17 directs onto the transparent plate 19 a beam of incident rays R_1 which is inclined with respect to said plate by an angle of incidence α. The phototransistor 18 is arranged along the path of a beam R_2 of rays that emerge from the plate 19 at an angle β, briefly termed reflection angle, with respect to said plate.

According to the invention, at the face of the plate 19 that is directed toward the drum 11 there are multiple optical reflection means 20 for bending the incident rays R_1 so that the angle β produced by the emerging rays R_2 is significantly different from the angle of incidence α.

In this manner, any light rays R_3 reflected by the thread or by any foreign matter or by the plate 19, which have a reflection angle (with respect to the plane of the plate 19) that is equal to the angle of incidence α, do not reach the phototransistor 18 and do not affect the signal emitted thereby. For this purpose, the optical reflection means 20 include a pair of opposite reflecting surfaces 21-22 which are inclined by respective angles δ and ϵ with respect to the plate and form a reflection triangle.

The incident rays R_1, which are inclined (minus a correction factor due to the refraction of the plate 19) by an angle $\alpha/2$ with respect to the first reflecting surface 21, strike said surface at a point of incidence A and are reflected, parallel to the plate 19, onto the surface 22, which they strike in a respective point of incidence B. The rays R_2 are reflected from this surface onto the plate 19, forming a reflection triangle A-B-V, and emerge from the plate 19 so as to form with it an angle which is equal (minus the refraction correction factor) to twice the reflection angle $\beta/2$ on the surface 22.

The inclinations δ and ϵ of the reflecting surfaces 21-22 are chosen so that they are equal to $90°-\alpha/2$ and $90°-\beta/2$ respectively, as clearly shown in figure 3. The same figure also shows that the incident rays R_1 and the emerging ones R_2 mutually intersect at the point V which coincides with the vertex of the reflection triangle and lies on the plane of the plate 19. In this manner, when a turn SP of the reserve of turns RF reaches the point V, it interrupts both beams R_1 and R_2, and the phototransistor 18, being completely screened from the light, emits a signal "s" that indicates the presence of turns; this signal, in accordance with the stated aim and objects, is fully free from uncertainties and has a constant and substantial amplitude.

The condition in which the intersection point V lies on the plate 19 occurs if

$$h = a \sin \alpha = b \sin \beta$$
$$1 = a \cos \alpha + b \cos \beta$$

where h is the altitude of the reflection triangle A-B-V, a and b are the sides of said triangle, and l is the base.

The plate 19 and the reflecting surfaces 21 and 22 can be part of a single optical prism such as 30, in which preferably the outer face of the surfaces 21 and 22 is covered with reflecting material. As an alternative, the surfaces 21 and 22 are constituted by individual mirrors which are supported by a container that is closed by the transparent plate 19.

Figure 4 illustrates the arrangement of a weft feeder such as 10 which includes, in addition to the described sensor S, a second identical sensor S' which is arranged at the base of the drum 11 to detect whether the weft thread F has broken and provide the loom, or other user machine, with a corresponding thread breakage signal.

Figures 5 and 6 illustrate a different embodiment of the sensor S according to the invention, particularly suitable for very fine or particularly

shiny weft threads. According to this embodiment, the incident rays R_1 and the emerging ones R_2 form, with respect to the plane of the plate 19, respective angles α and β that can be indifferently equal or different, and the extensions of said rays mutually intersect at a virtual point V' that lies outside the plate 19 on the side where the photodiode 17 and the phototransistor 18 are located. A cup-shaped recess 31 is formed on the plate 19 and accommodates a stud 32 that cooperates with the multiple-reflection means 20. The stud 32, which is made of opaque material, can move in contrast with the action of a spring 33 and has an enlarged head 34 shaped like a spherical segment and a stem 35 that extends beyond the bottom of the recess 31, at right angles to the plane of the plate 19, on the side of the reflecting surfaces 21 and 22. The stud 32 is normally retained by the spring 33 in the inactive position shown in figure 5, in which the head 34 protrudes with respect to the plate 19. In this inactive position, the stem 35 lies above the base "1" of the reflection triangle A-B-V' and therefore does not interfere with the rays reflected by the reflecting surface 21 onto the reflecting surface 22. Accordingly, a beam of reflected rays R_2 strikes the phototransistor 18. When one or more turns SP of the reserve RF reach the head 34 of the stud 32, they make said stud move, in contrast with the action of the spring 33, into an active position (32a) in which the stem 35 of the stud interferes with the beam reflected by the surface 21 onto the surface 22 (figure 6), screening the phototransistor 18 from the light and making it thus emit the turn presence signal "s".

Naturally, without altering the concept of the invention, the details of execution and the embodiments may be changed extensively with respect to what has been described and illustrated by way of non-limitative example, without thereby abandoning the scope of the invention.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Optical device for detecting the presence of a reserve of weft (RF) and/or the breakage of the weft thread (F) on weft feeders (10) for textile machines, characterized in that it comprises an emitter diode (17) and a receiver phototransistor (18) which are arranged at the same face of a transparent plate (19) associated with the drum (11) of the weft feeder (10) and suitable to receive the turns of the weft reserve (RF); in that the emitter (17) directs onto the transparent plate (19) a beam of rays (R_1) which is tilted at a preset angle of incidence (α), and in that the receiver (18) receives a beam of rays (R_2) that emerge from the transparent plate (19) and form an angle of reflection (β), with respect to said plate, which is different from the angle of incidence (α) produced by multiple-reflection means (20) located at the other face of the transparent plate (19), and in that the incident rays (R_1) and/or the emerging rays (R_2) are interrupted by a turn (SP) of the reserve of thread (RF) when said turn reaches the plate (19), so as to screen the receiver (18) from the light, said receiver emitting a corresponding turn presence signal (s).

2. Device according to claim 1, characterized in that said multiple-reflection means (20) include a pair of opposite reflecting surfaces (21-22) and in that the incident rays emitted by the emitter (17) are reflected by the first reflecting surface (21) onto the second reflecting surface (22) to be sent onto the transparent plate (19) at the preset reflection angle (β); said reflecting surfaces forming a reflection triangle (A-B-V) the base (1) whereof coincides with the line connecting the points of incidence (A-B) of the rays on said reflecting surfaces (21-22) and is parallel to the reflecting plate (19).

3. Device according to claim 2, characterized in that the incident rays (R_1) and the emerging rays (R_2) intersect at a point (V) that lies on the plane of the plate (19) so that the presence of a turn (SP) of the reserve (RF) in said point (V) simultaneously interrupts the incident rays (R_1) and the emerging rays (R_2).

4. Device according to claims 2 and 3, characterized in that said reflecting surfaces (21-22) are inclined with respect to the plane of the transparent plate (19) by respective angles (δ-ϵ) that depend on the angle of incidence (α) and respectively on the reflection angle (β).

5. Device according to claim 4, characterized in that the inclination angle (δ) of the first reflecting surface (21) with respect to the transparent plate (19) is equal to a right angle (90°) minus half the angle of incidence (α), and in that the inclination (ϵ) of the second reflecting plate with respect to the transparent plate (19) is equal to a right angle (90°) minus half the reflection angle (β).

6. Device according to the preceding claims, characterized in that the transparent plate (19) and the reflecting surfaces (21-22) are part of a single optical prism (30).

7. Device according to claims 1 to 5, characterized in that the reflecting surfaces (21-22) are constituted by individual mirrors accommodated in a container that is closed by said transparent plate (19).

8. Optical device for detecting the presence of a reserve of weft and/or the breakage of the weft on weft feeders for textile machines, characterized in that it comprises an emitter diode (17) and a receiver phototransistor (18) which are arranged at the same face of a transparent plate (19); in that the emitter (17) directs onto the plate (19) a beam of incident rays (R_1); in that the receiver (18) receives a beam of rays (R_2) that emerge from said plate (19); in that the incident rays (R_1) are reflected by multiple-reflection means (20) which are arranged at the other face of the plate (19) and include a first and a second reflecting surfaces (21-22); in that the plate (19) has a movable stud (32), made of opaque material, with a stem (35) suitable to interrupt the rays reflected by the first reflecting surface (21) onto the second reflecting surface (22) in order to screen the receiver (18) from the light when a turn (SP) of the reserve (RF) reaches said stud, making it move from an inactive position to an active position; the screened receiver (18) emitting a corresponding signal (s) indicating the presence of the turn.

9. Device according to claim 8, characterized in that said first and second reflecting surfaces (21-22) form a reflection triangle (A-B-V') the base (1) whereof is parallel to the transparent surface (19), and in that the stem (35) of the stud (32) is arranged above said base (1) when the stud is in its inactive position and interferes with said base (1) when the stud is in its active position.

10. Device according to claims 8 and 9, characterized in that the stud (32) is accommodated in a cup-shaped recess (31) formed on the transparent plate (19) and has an enlarged head (34) shaped like a spherical segment which, in the inactive position of the stud, protrudes from the plane of the plate (19); said stud being kept in its inactive position by the action of a spring (33) that acts on said head (34) and reacts on the bottom of the cup-shaped recess (31).

11. Device according to claims 8 to 10, characterized in that the stem (35) of the stud (32) extends beyond the bottom of the cup-shaped recess (31) at right angles to the transparent plate (19).

12. Weft feeder (10) with a fixed drum (11) that contains a reserve of thread (RF) formed by turns of thread wound on the drum, characterized in that it comprises an optical device (S) according to claims 2 to 7, or 8 to 11, which is arranged at the head of the drum (11) in order to detect the presence of said turns that form the weft reserve.

13. Weft feeder (10) according to claim 12, characterized in that it comprises an additional optical sensor (S') according to claims 2 to 7, or 8 to 11, which is arranged at the base of the drum (11) to indicate the breakage of the weft thread (F).

14. Weft detection optical device, comprising:

a transparent plate (19) arrangeable on a weft feeder drum (11) so that weft threads are windable on the transparent plate;

emitter diode means (17) positioned for emitting incident light rays (R_1) towards said plate at an angle of incidence (α) with respect to said transparent plate;

multiple optical reflection means (20) for reflecting the incident light rays as reflected rays (R_2) which emerge from the transparent plate at an angle (β) with respect to the plate; and

phototransistor means (18) positioned for receiving the reflected rays (R_2), wherein the presence of a weft thread on the transparent plate at a critical point (SP) thereof prohibits the generation of the reflected rays (R_2), which lack of generation is detected by the phototransistor means, while reflected rays (R_3) from the thread substantially do not reach the phototransistor means (18), and wherein the phototransistor means (18) receive the reflected rays when the weft thread is not present at the critical point of the transparent plate.

15. The device of claim 14, wherein the angle of incidence (α) is different from the angle of emergence (β), and wherein the critical point is the intersection point of the incident light rays with the transparent plate.

16. The device of claim 14, further comprising a spring biased stem (35) positioned at the transparent plate (19) and susceptible to the

presence of a weft thread which pushes the stem in said multiple optical reflection means (20) for blocking the reflected rays (R_2).

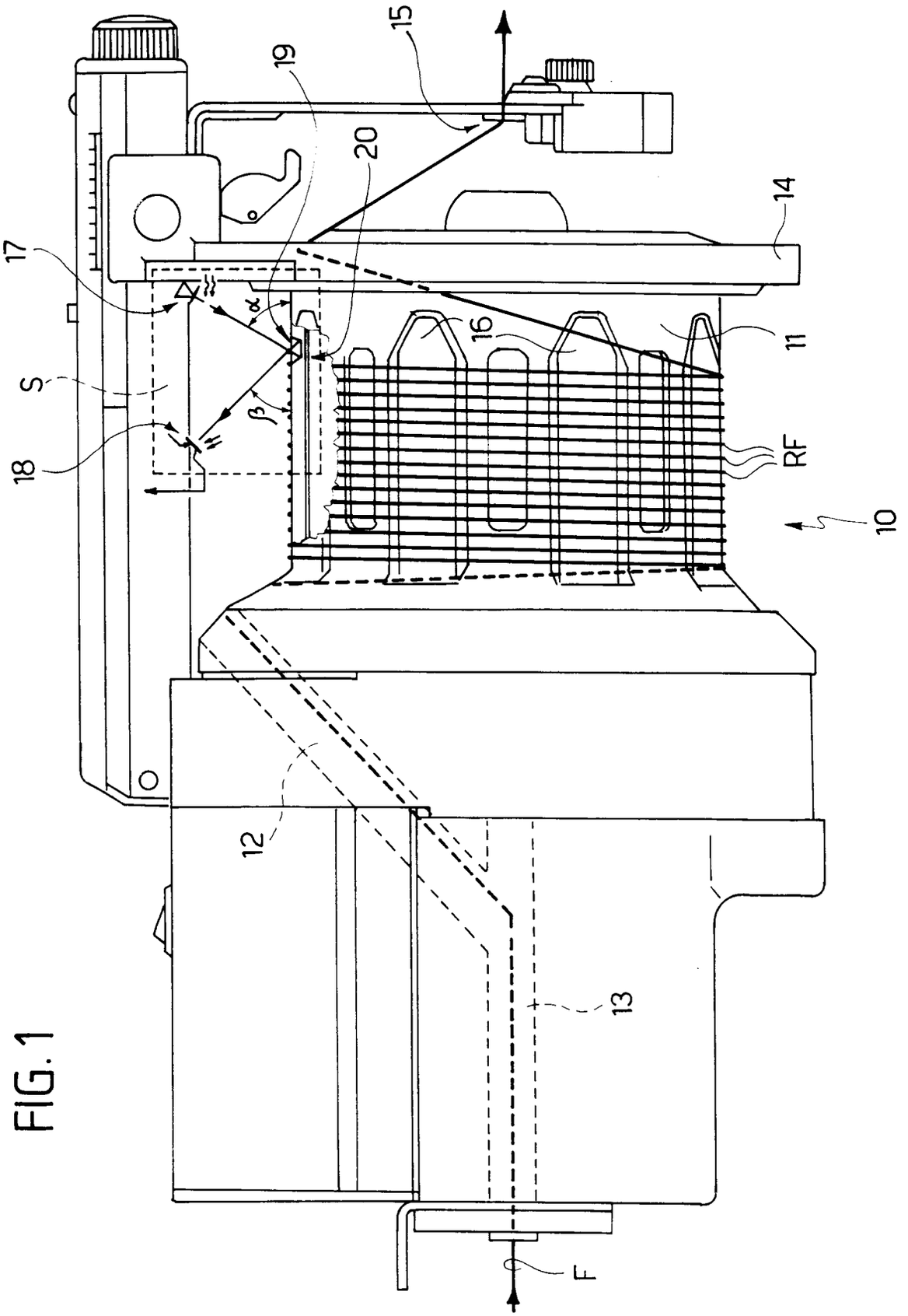

FIG. 1

FIG. 2

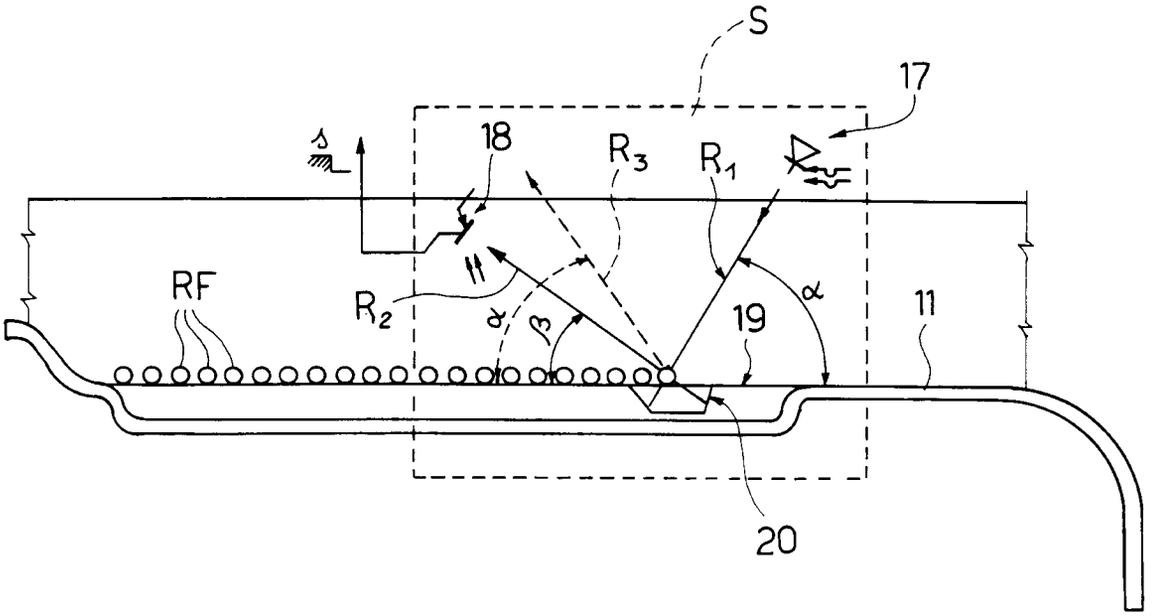

FIG. 4

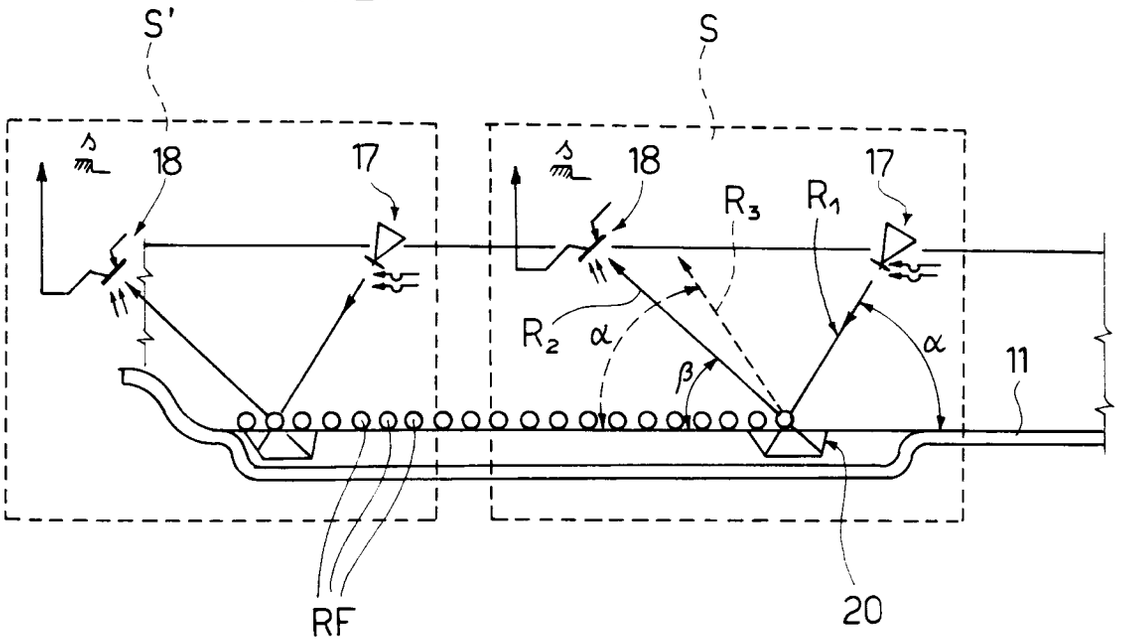

FIG. 3

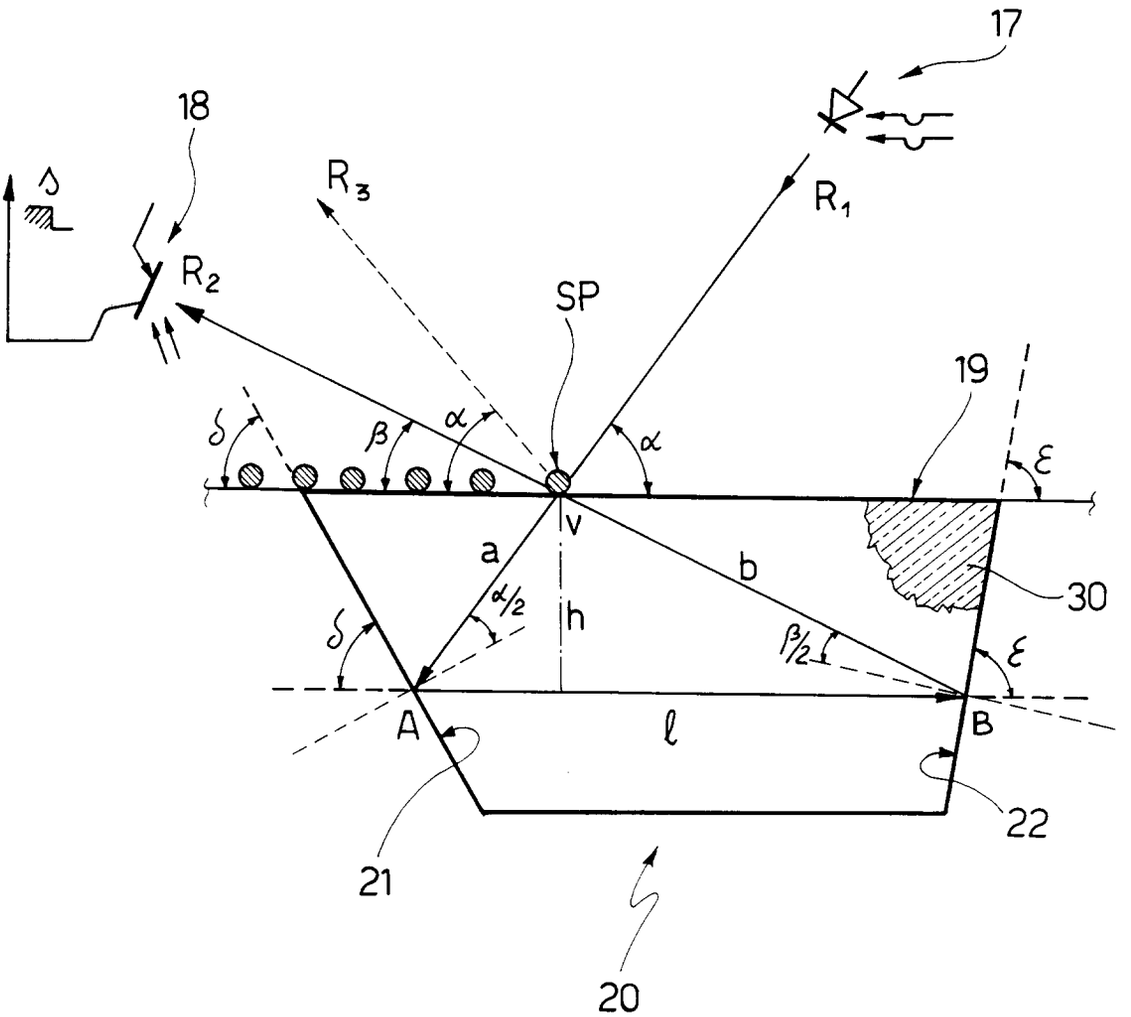

FIG. 5

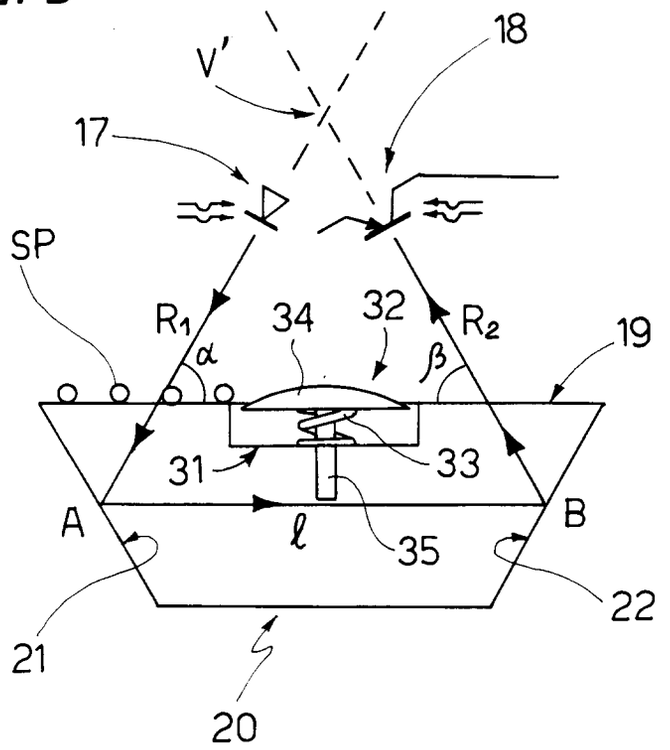
V'
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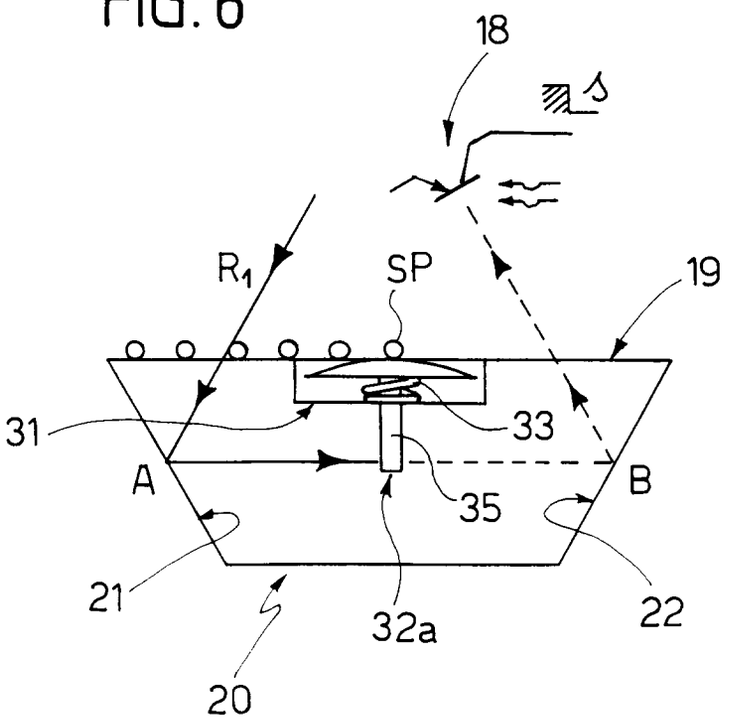
FIG. 6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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 7218

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	EP-A-0 327 973 (ROJ ELECTROTEX) * column 5, line 2 - column 6, line 41; figures 1,2 *	1,12	D03D47/34 B65H63/032
A	EP-A-0 199 059 (ROJ ELECTROTEX) * abstract; figure 2 *	1,12	
A	DE-B-12 88 339 (REINERS) * column 3, line 5 - column 4, line 4; figure 1 *	1	
A	EP-A-0 174 039 (PICANOL)		
A	WO-A-92 09516 (IRO)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
D03D
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 August 1994	Boutelegier, C

CATEGORY OF CITED DOCUMENTS

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