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(71) Applicant:
NISHIMOTO SANGYO Co., LTD.
Osaka-shi, Osaka 540 (JP)

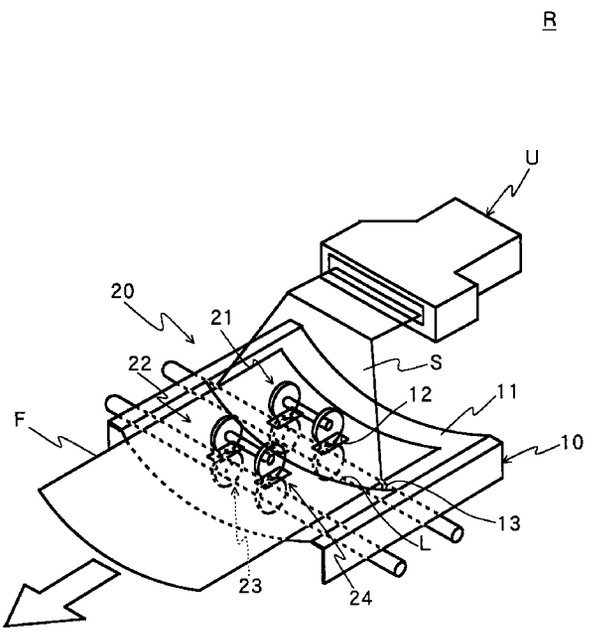
(72) Inventors:
- **KOTANI, Haruo**
  Osaka 569 (JP)
- **IWASA, Tadashi**
  Saitama 350 (JP)
- **OKAZAKI, Makoto**
  Koto-ku,Tokyo 136 (JP)

(74) Representative:
VOSSIUS & PARTNER
Siebertstrasse 4
81675 München (DE)

(54) READING DEVICE FOR TRANSMISSION TYPE FILM

(57) A reading apparatus (R) of transmission type film comprising a film holding means having an arc surface (11) similar to a free deflection curve of film (F), and a film conveying means having a driving roller (23) disposed beneath the arc surface (11), a driven roller (24) disposed above the arc surface (11) corresponding to the driving roller (23), for bringing the driving member of the driving roller (23) into contact with the film (F) back side and the driven member of the driven roller (24) into contact with the film (F) face side.

F I G . 1



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Description

TECHNICAL FIELD

The present invention relates to a reading apparatus of transmission type film. More particularly, it relates to a reading apparatus of transmission type film simplified in the laser optical system.

BACKGROUND ART

Hitherto, in a reading apparatus of transmission type film for medical use (hereinafter called reading apparatus), as shown in Fig. 18, a laser beam c emitted from a semiconductor laser device a and focused by a focusing lens b is reflected by a polygonal mirror d, and a film f surface held in a flat plane is scanned (main scanning). In this case, to correct the optical path length, an F-Θ lens g is interposed between the polygonal mirror d and film f, and to correct plane tilting, moreover, a cylindrical lens h is disposed after the F-Θ lens g. After main scanning, the film f is conveyed, for example, downward while the deflection in the main scanning direction of the film f is being suppressed by a pair of cylindrical driving rollers i, i and a pair of cylindrical driven rollers j, j as shown in Fig. 19. This is sub-scanning of film f. Alternatively, it is designed to drive by using a set of combination of driving roller i and driven roller j as shown in Fig. 20. In Fig. 20, reference code k denotes a scanning unit on which an optical system such as polygonal mirror d is mounted. In such constitution, the sub-scanning mechanism of film f is simplified by using cylindrical rollers i, j, but, to the contrary, the optical characteristic depends on the F-Θ lens g, and the F-Θ lens g is expensive, and the cost of the reading apparatus is raised.

To solve these problems of the reading apparatus composed by using the F-Θ lens g, as shown in Fig. 21, a reading apparatus is proposed to compose a film conveying mechanism, in which the film f surface is an arc surface along the main scanning direction, and sub-scanning is realized by combination of barrel roller m and drum roller n. However, when the film f is conveyed by such conveying mechanism, although deflection in main scanning direction of the film f is suppressed, sub-scanning is not smooth because the peripheral speed differs between the central part and circumferential part of the rollers m, n.

It is hence an object of the invention to solve the problems of the prior art, and to present a reading apparatus of transmission type film capable of reading the film precisely without using F-Θ lens g.

DISCLOSURE OF THE INVENTION

It is a first aspect of the invention to present a reading apparatus of transmission type film comprising a film conveying means for conveying a film on an arc surface similar to a free deflection curve of film.

The first aspect of the invention, more specifically, relates to a reading apparatus of transmission type film comprising a film holding means having an arc surface similar to a free deflection curve of film, and a film conveying means having a driving roller disposed beneath the arc surface, a driven roller disposed above the arc surface corresponding to the driving roller, for bringing the driving member of the driving roller into contact with the film back side and the driven member of the driven roller into contact with the film face side.

Preferably, in the first aspect of the invention, the driving member of the driving roller is a pair of driving wheels disposed at a specific interval on a drive shaft, and the driven member of the driven roller is a pair of driven wheels mounted on a shaft member corresponding to the driving wheels.

Preferably, in the first aspect of the invention, the abutting surface of the driving wheels and driven wheels with the film is an arc surface.

Preferably, in the first aspect of the invention, the driven roller is free to ascend and descend.

Preferably, the first aspect of the invention further comprises a box-shaped main body composed of parallel ceiling member and bottom member having the longitudinal direction in the scanning direction of laser beam constituted by combining flat members, a pair of photo detecting means disposed at proper positions on planes parallel to the scanning plane of laser beam of the main body, and a focusing device for film density detector forming a ceiling member contacting with the back side of a shell member on which the film of the box-shaped main body is mounted and conveyed, along the back side of the shell member, and forming a slit along the scanning direction of the laser beam for moving the laser beam forward into the main body in this ceiling member.

Herein, the slit is covered, for example, with a scattering film for scattering the light appropriately, and a coating is formed inside of the box-shaped main body for preventing absorption of laser beam getting into the main body.

Preferably, the first aspect of the invention further comprises film width aligning means.

Herein, the width aligning means has a width aligning member free to move back and forth in the film width direction disposed oppositely.

It is a second aspect of the invention to present a film conveying device used in a reading apparatus of transmission type film, for conveying a film on an arc surface similar to a free deflection curve of film.

More specifically, the film conveying device in the second aspect of the invention comprises film holding means having an arc surface similar to a free deflection curve of film, a driving roller disposed beneath the arc surface, and a driven roller disposed above the arc surface corresponding to the driving roller, in which the driving member of the driving roller contacts with the

film back side, and the driven member of the driving roller contacts with the film face side.

In the second aspect of the invention, two sets of combination of driving roller and driven roller are used, and each set is disposed oppositely across the main scanning surface.

Preferably, in the second aspect of the invention, the driving member of the driving roller is a pair of driving wheels disposed at a specific interval on a drive shaft, and the driven member of the driven roller is a pair of driven wheels mounted on a shaft member corresponding to the driving wheels.

Preferably, in the second aspect of the invention, the abutting surface of the driving wheels and driven wheels with the film is an arc surface.

Preferably, in the second aspect of the invention, the driven roller is free to ascend and descend.

It is a third aspect of the invention to present a focusing device for film density detector used in a film density detector for detecting the film density by mounting and conveying a film on the top of a shell member formed in an arc, scanning the conveyed film surface with laser beam, and focusing the transmitted light, comprising a box-shaped main body composed of parallel ceiling member and bottom member having the longitudinal direction in the scanning direction of laser beam constituted by combining flat members, and a pair of photo detecting means disposed at proper positions on planes parallel to the scanning plane of laser beam of the main body, further forming a ceiling member contacting with the back side of a shell member on which the film of the box-shaped main body is mounted and conveyed, along the back side of the shell member, and forming a slit along the scanning direction of the laser beam for moving the laser beam forward into the main body in this ceiling member.

Preferably, in the third aspect of the invention, the slit is covered with a scattering film for scattering the light appropriately.

Preferably, in the third aspect of the invention, a coating is formed inside of the box-shaped main body for preventing absorption of laser beam getting into the main body.

Since the first aspect of the invention is thus constituted, without using F-Θ lens in the scanning unit, the reading precision of transmission type film is enhanced.

Since the second aspect of the invention is thus constituted, the film runs along the arc surface only by mounting the film on the arc surface. Accordingly, it is not necessary to move the film along the conveying surface by pressing by the driving roller and driven roller, so that the constitution of the driving roller and driven roller may be simplified.

Since the third aspect of the invention is thus constituted, the film conveyed nearly in an arc form can be kept nearly in tight contact over the entire width, and the scanning speed of laser beam may be constant regardless of the focusing device for film concentration detector, and the reading apparatus of transmission type film on which it is mounted is not increased in size.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an essential perspective view of a reading apparatus of transmission type film of the invention.

Fig. 2 is a lateral sectional view of the reading apparatus.

Fig. 3 is a left side view showing a partial section of the reading apparatus.

Fig. 4 is a sectional view of a right side leading end portion of the reading apparatus.

Fig. 5 is a schematic diagram of a film conveying mechanism.

Fig. 6 is an explanatory diagram showing the circumferential shape of driving wheel and driven wheel.

Fig. 7 is an explanatory diagram of disposing method of driving wheel and driven wheel, in which the extension line of the central line of the driving wheel and driven wheel passing through the center of curvature of the arc table in (a), and it is vertical in (b).

Fig. 8 is a schematic diagram of a link mechanism used in the reading apparatus.

Fig. 9 is a perspective view of a focusing device for film density detector used in the reading apparatus.

Fig. 10 is its perspective exploded view.

Fig. 11 is a perspective view showing the focusing device separated from the arc table.

Fig. 12 is a perspective exploded view of width aligning mechanism of film.

Fig. 13 is an operation explanatory diagram of a reading apparatus of the invention, showing an initial state of the reading apparatus.

Fig. 14 is the operation explanatory diagram, showing a film inserted state.

Fig. 15 is the operation explanatory diagram, showing a lowered state of an upper guide.

Fig. 16 is the operation explanatory diagram, showing a state of the film end being pulled in to a position dislocated from the laser beam.

Fig. 17 is the operation explanatory diagram, showing a discharged state of a film being read.

Fig. 18 is an explanatory diagram of an optical system in a conventional reading apparatus.

Fig. 19 is a schematic diagram of a film conveying device in the same reading apparatus.

Fig. 20 is a schematic diagram of other example of the conventional reading apparatus.

Fig. 21 is a schematic diagram of a different example of the conventional reading apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the accompanying drawings, embodiments of the invention are described below, but it must be noted that the invention is not limited to the illustrated embodiments alone.

A perspective view of essential parts of a reading apparatus of transmission type film for medical use (hereinafter called reading apparatus) R in an embodiment of the invention is given in Fig. 1, and a front sectional view, a left side view, and a partial right side view of the reading apparatus R are shown in Fig. 2, Fig. 3, and Fig. 4, respectively. This reading apparatus R comprises, as shown in the drawings, a scanning unit U, an arc table 10 having an arc surface 11 in an arc form along the main scanning direction L of a film F, a film conveying mechanism 20 for sub-scanning of film F mounted on this arc surface 11, and a focusing device for film density detector (hereinafter called focusing device) 30, as principal constituent elements.

The scanning unit U is similar to the conventional scanning unit except that the F-Θ lens is not provided.

The arc table 10 has the arc surface 11 similar to a free deflection curve of the film F formed when supporting the end of the film F orthogonal to the main scanning direction L. For example, in a film F of 14-inch width, the radius of curvature of the arc surface 11 is about 300 mm. By thus forming the arc surface 11, when the film F is put on the arc table 10, since the film F is naturally fitted to the arc surface 11, it is possible to equalize the optical path length from the polygonal mirror (not shown) mounted on the scanning unit U at each position along the main scanning direction L of the film F surface without having to press the film F by roller or the like.

The film conveying mechanism 20 is composed of a first drive unit 21 and a second drive unit 22 disposed across the main scanning surface S as shown in Fig. 1, and each one of the first drive unit 21 and second drive unit 22 is a combination of a driving roller 23 and a driven roller 24 similarly composed as shown in Fig. 5. This driving roller 23 is composed of a pair of driving wheels 23b, 23b in a plate form disposed at a specific interval on a drive shaft 23a driven, for example, by a motor through a power transmission mechanism, and the driven roller 24 is composed of a pair of driven wheels 24b, 24b in a plate form disposed on a shaft 24a held rotatably on an elevatable member through proper means corresponding to the driving wheels 23b, 23b. The outer circumferences 23c, 24c of the driving wheel 23 and driving wheel 24b are arc surfaces as shown in Fig. 6. Since the outer circumferences 23c, 24c of the driving wheel 23b and driven wheel 24b are thus formed, useless deformation of the film F when the driving wheel 23b and driven wheel 24b pinch the film F is prevented.

Thus constituted driving roller 23 is disposed beneath the arc table 10 so that the outer circumference 23c of the driving wheel 23b may contact with the back side of the film F, and the driven roller 24 is disposed above the arc table 10 so that the outer circumference 24c of the driven wheel 24b may contact with the face side of the film F. Accordingly, at a position corresponding to the arc table 10, as shown in Fig. 1, a window 12 is provided so that the driving wheel 23b may project from the surface of the arc surface 11. In this case, as shown in Fig. 7 (a), it is preferred to dispose so that the extension line of the central line of the driving wheel 23b and driven wheel 24b may pass through the center of curvature O of the arc table 10, but when preferred to avoid complicated structure of drive mechanism, as shown in Fig. 7 (b), the driving wheel 23b and driven wheel 24b may be disposed vertically. By such constitution of four-point driving and driven structure, the film is conveyed stably, preventing meandering and sliding of film F. A power transmission mechanism 25 for driving the driving roller 23 is, as shown in Fig. 2 and Fig. 3, composed of a shaft side transmission member 25a fitted to the end portion of the drive shafts 23a, 23a, a motor side transmission member 25b fitted to the end portion of the drive shaft of motor M1, and a belt 25c applied between the shaft side transmission members 25a, 25a and motor side transmission member 25b.

An elevatable member holding the driven roller 24 is specifically an upper guide 26 moved up and down by a link mechanism. This upper guide 26 comprises, as shown in Fig. 3 to Fig. 5, a first holder 26a holding the driven roller 24 of the first drive unit 21, a second holder 26b holding the driven roller 24 of the second drive unit 22, an upper guide main body 26c holding the first holder 26a and second holder 26b, a link 26d for moving up and down the guide main body 26c, and a rotary disk 26e, and the upper end of the link 26d is joined by pin at a proper position of the upper guide main body 26c, and the lower end is joined by pin at an outer circumference of the rotary disk 26e. This link 26d is specifically composed of an upper link 26f and a lower link 26g, and the lower end of the upper link 26f and the upper end of the lower link 27g are rotatably joined (see Fig. 8). A slot 26h is formed at the leading end of the upper link 26f, and a pin 26i planted on the guide main body 26c is slidably engaged with this slot 26h. A proper position in the center of the upper link 26f is oscillatably fitted by pin. On the other hand, the lower end of the lower link 26g is rotatably joined by pin to the rotary disk 26e as mentioned above.

As the upper guide 26 is thus constituted, when the rotary disk 26e is rotated by motor M2, the upper guide main body 26c is moved up or down, and the first holder 26a and second holder 26b held by it are also moved up or down. That is, the driven rollers 24, 24 ascend or descend. Incidentally, the mechanism for moving up and down the driven rollers 24 is not limited to the above constitution, but other proper means may be used, and, for example, it may be designed to move up and down by chain drive.

The focusing device 30 comprises, as shown in Fig. 9 through Fig. 11, a main body 40, and a photo detector 50 disposed at a proper position of this main body.

The main body 40 is, as shown in Fig. 10 and Fig. 11, is a box (focusing box) 40A of rectangular section, with the top 40a formed in an arc form in a curvature corresponding to the curvature of the arc surface 11, so

as to be mounted on the back side 11a of the arc surface 11a along the width direction of the arc table 10. This box 40A is formed by assembling, as shown in Fig. 2, a ceiling plate 41 formed in a curved surface corresponding to the curved surface of the arc surface 11 abutting against the back side 11a of the arc surface 11, a right side plate 42, a left side plate 43, a front plate 44 having the upper end formed in an arc along the inner side of the ceiling plate 41, a rear plate 45 having the upper end formed in an arc along the inner side, and a bottom plate 46 formed in the curved surface in a concentric circle with the ceiling plate 41. Herein, the longitudinal direction is based on the conveying direction of the film F (see arrow in Fig. 11).

These plates 41, 42, 43, 44, 45, 46 are assembled, for example as shown in Fig. 10, by forming assembly plates 42a, 43a for assembling the ceiling plate 41 outward to the upper end of the right side plate 42 and left side plate 43 integrally in a proper size, fastening these assembly plates 42a, 43a formed outward from both ends of the ceiling plate 41 corresponding to these assembly plates 42a, 43a with screws, forming assembly plates 42b, 43b for assembling the front plate 44 outward to the front end of the right side plate 42 and left side plate 43 integrally in a proper size, fastening the both ends of the front plate 44 to the assembly plates 42b, 43b with screws, having the upper end abutting against the inner side of the ceiling plate 41, forming assembly plates 42c, 43c for assembling the rear plate 45 outward to the rear end of the right side plate 42 and left side plate 43 integrally in a proper size, fastening the both ends of the rear plat 45 to these assembly plates 42c, 43c with screws, having the upper end abutting against the inner side of the ceiling plate 41, forming stopping holes 42d, 43d in the bottom of the right side plate 42 and left side plate 43, stopping the stopping protrusions 45a, 45a formed corresponding to these stopping holes 42d, 43d at the end of the bottom plate 46 in the stopping holes 42d, 43d disposing an assembly plate 47 having assembly portions 47a provided downward from the end of the bottom plate 46 at proper intervals in the front and rear portions of the back side of the bottom plate 46, and fastening the bottom of the front plate 44 and rear plate 45 to the assembly portions 47a with screws.

Thus assembled focusing box 40A is assembled in the back side 11a of the laser beam irradiation position from the scanning unit U of the arc surface 11 of the arc table 10, and light is focused. That is, the light passing through a slit 13 formed at the laser beam irradiation position from the scanning unit U of the arc surface 11 penetrates and invades a slit 41b formed corresponding to the slit 13 in the ceiling plat 41 in the focusing box 40A, and the laser beam invading into the focusing box 40A is irregularly reflected repeatedly in the focusing box 40A, and enters a photo detector 50 provided in a pair of mounting members 48 formed at a proper interval in the rear plat 45, and the laser beam entering the photo detector 50 is converted into an electric signal same as in prior art, and is sent out into a density detector (not shown). The density detector detects, same as in prior art, the density of the laser beam passing through the film F by the signal entering from the photo detector 50. The focusing box 40A is assembled into the arc table 10 by, for example, stopping the screws assembling the ceiling plate 41 into the side plates 42, 43 into the arc table 10 (see Fig. 11).

In this case, only by properly scattering the laser beam penetrating the slit 41b formed in the ceiling plate 41, it uniformly gets into the focusing box 40A, and therefore the position of forming the slit 41b in the ceiling plate 41 is covered with a scattering film 49. As this scattering film 49, for example. Scotch Mending Tape (a tradename of Sumitomo-3M) may be used by removing its adhesive.

The inside of the focusing box 40A is coated in order to focus the laser beam entering the focusing box 40A by decreasing the absorption in the inside of the focusing box 40A. For this coating, for example, a water-based acrylic paint and barium sulfate are mixed at 1 to 10 by volume, and dissolved in purified water to prepare a creamy paint, which is applied in multiple layers. This coating is applied while properly polishing with sandpaper so as to remove extra undulations from the surface.

More specifically, the coating procedure is as follows.

(1) The ceiling plate 41, right and left side plates 42, 43, front plate 44, rear plate 45, and bottom plate 46 are degreased by cleaning with alcohol.

(2) A coating material is prepared. For example, water-based acrylic paint and barium sulfate are mixed at 1 to 10 by volume, and dissolved in purified water to prepare like whipped cream. The water-based acrylic paint used herein is Floor White (a tradename of Nippon Paint), and barium sulfate is Baritogen Deluxe (a tradename of Fushimi Seiyakusho).

(3) The obtained coating material is sparingly applied on each inner surface of ceiling plate 41, right and left side plates 42, 43, front plate 44, rear plate 45, and bottom plate 46. This is so-called surface conditioning of the inner surfaces of 41, 42, 43, 44, 45, 46.

(4) When the surface conditioning agent is dried, an undercoat is applied. In this case, the thickness of coat film is in a range of 1 mm to 2 mm.

(5) When the undercoat is dried, the surface is polished flat with sandpaper to remove undulations of coat film.

(6) After polishing with sandpaper, the focusing box 40A is assembled in a semi-finished state, except for the ceiling plate 41 and rear plate 45.

(7) In the semi-finished state of the focusing box 40A, a middle coat is applied. This middle coat is also applied to the ceiling plate 41 and rear plate 45

which have not been assembled yet. In this case, the thickness of the coat film is in a range of 2 mm to 3 mm.

(8) When the middle coat is dried, the surface is polished flat with sandpaper to remove undulations of coat film.

(9) After polishing with sandpaper, a top coat is applied. This top coat is also applied to the ceiling plate 41 and rear plate 45 which have not been assembled yet. In this case, the thickness of the coat film is in a range of 3 mm to 4 mm.

(10) When the top coat is dried, the surface is polished flat with sandpaper to remove undulations of coat film. At this time, the thickness of coat film is 3 mm or more.

(11) The rear plate 45 is assembled in the semi-finished focusing box 40A.

(12) The coating material is applied on the abutting portions of the plates 42, 43, 44, 45 of the focusing box 40A with the ceiling in open state.

(13) The ceiling plate 41 is assembled to complete the focusing box 40A.

Fig. 11 and Fig. 12 show a width aligning mechanism 60 for adjusting the width direction position of the film F used in this embodiment. The width aligning mechanism 60 comprises a width aligning member 61, a drive mechanism 62 for driving the width aligning member 61, and a mounting member 63 for mounting the width aligning member 61 on the drive mechanism 62, and a set of confronting width aligning mechanisms 60 is disposed in the arc table 11 across a specific interval (see Fig. 11). As thus disposed width aligning members 61 move along the guide groove 14 provided in the arc surface 11, the film F is aligned in width.

The drive mechanism 62 specifically comprises a flexible rack 64 made of synthetic resin, and a motor (not shown) having a pinion for driving the rack 64. The rack 64 is slidably provided in a guide 15 disposed at a proper position of the back side 11a of the arc surface 11.

In Fig. 12, reference numeral 65 is a bolt for rotatably fixing the width aligning member 61, 66 is a nut to be combined with this bolt, 67 is a bolt for fixing the mounting member 63 to the rack 64, and 68 is a spacer nut to be combined with the bolt 64.

Referring also to Fig. 13 to Fig. 17, reading of the film F by thus constituted reading apparatus R is described. In the following operation, each action is instructed by the control device N.

(1) The power source is turned on, and the upper guide 26 is pulled up to a specified position (see Fig. 13).

(2) The film F is manually inserted and set in the reading apparatus R through the inlet (see Fig. 14).

(3) The upper guide 26 is lowered to a specified position, and the film F is held between the drive rollers 23, 23 and driven rollers 24, 24 (see Fig. 15).

(4) Driving the first drive unit 21 and second drive unit 22, the end of the film F is pulled until dislocated from the laser beam from the scanning unit U (see Fig. 16).

(5) When the film F is conveyed by the first drive unit 21 and second drive unit 22 and the end of the film F reaches a specified position, the first drive unit 21 and second drive unit 22 are stopped, and conveying of the film F is stopped.

(6) A laser beam is emitted from the scanning unit U, and scan (main scanning) is started.

(7) When scanning of one line is over, emission of laser beam from the scanning unit U is stopped, and the first drive unit 21 and second drive unit 22 are driven again, and the film F is fed by a specified amount.

Thereafter, the specified range of the film F is scanned similarly.

Thus, according to the embodiment, although the film conveying mechanism is simplified, the F-Θ lens in the optical system can be omitted. Therefore, the cost of the reading apparatus R including the scanning unit U is lowered. Also according to the embodiment, since the focusing device 30 is mounted on the back side 11a along the width direction of the arc surface 11 of the arc table 10, the width of the focusing device 30 may be a minimum required limit, and the scanning speed with the laser beam may be constant in the entire irradiation area so as to be focused by the focusing device 30. As a result, the precision of concentration detection can enhanced while preventing useless increase in size of the reading apparatus R. Moreover, since the focusing box 40A composing the focusing device 30 is formed by combining flat plates, manufacturing is easy, including coating of inside.

INDUSTRIAL APPLICABILITY

According to the invention thus described specifically, although the film conveying mechanism is simplified, the F-Θ lens in the optical system can be omitted. Therefore, the cost of the reading apparatus including the scanning unit U is lowered.

Also according to the invention, since the focusing device for film density detector is mounted on the back side of the arc surface along the width direction of the arc table of the reading apparatus, the width of the focusing device for film density detector may be a minimum required limit, and moreover the scanning speed with the laser beam may be constant in the entire irradiation area so as to be focused by the focusing device for film density detector. As a result, the precision of concentration detection can enhanced while preventing useless increase in size of the reading apparatus. Still more, since the focusing box composing the focusing device for film density detector is formed by combining

flat plates, manufacturing is easy, including coating of inside.

Claims

1. A reading apparatus of transmission type film comprising a film conveying means for conveying a film on an arc surface similar to a free deflection curve of film.

2. A reading apparatus of transmission type film comprising film holding means having an arc surface similar to a free deflection curve of film, and a film conveying means having a driving roller disposed beneath said arc surface, a driven roller disposed above said arc surface corresponding to said driving roller, for bringing the driving member of said driving roller into contact with the film back side and the driven member of said driven roller into contact with the film face side.

3. The reading apparatus of transmission type film of claim 2, wherein two sets of combination of driving roller and driven roller are used, and each set is disposed oppositely across the main scanning surface.

4. The reading apparatus of transmission type film of claim 2, wherein the driving member of said driving roller is a pair of driving wheels disposed at a specific interval on a drive shaft, and the driven member of said driven roller is a pair of driven wheels mounted on a shaft member corresponding to said driving wheels.

5. The reading apparatus of transmission type film of claim 4, wherein the abutting surface of the driving wheels and driven wheels with the film is an arc surface.

6. The reading apparatus of transmission type film of claim 2, wherein said driven roller is free to ascend and descend.

7. The reading apparatus of transmission type film of claim 2, further comprising a box-shaped main body composed of parallel ceiling member and bottom member having the longitudinal direction in the scanning direction of laser beam constituted by combining flat members, a pair of photo detecting means disposed at proper positions on planes parallel to the scanning plane of laser beam of said main body, and a focusing device for film density detector forming a ceiling member contacting with the back side of a shell member on which the film of said box-shaped main body is mounted and conveyed, along the back side of said shell member, and forming a slit along the scanning direction of the laser beam for moving the laser beam forward into the main body in this ceiling member.

8. The reading apparatus of transmission type film of claim 7, wherein said slit is covered with a scattering film for scattering the light appropriately.

9. The reading apparatus of transmission type film of claim 7, wherein a coating is formed inside of said box-shaped main body for preventing absorption of laser beam getting into the main body.

10. The reading apparatus of transmission type film of claim 1 or 2, further comprising film width aligning means.

11. The reading apparatus of transmission type film of claim 10, wherein said width aligning means has a width aligning member free to move back and forth in the film width direction disposed oppositely.

12. A film conveying device, being a film conveying device used in a reading apparatus of transmission type film, for conveying a film on an arc surface similar to a free deflection curve of film.

13. A film conveying device comprising film holding means having an arc surface similar to a free deflection curve of film, a driving roller disposed beneath said arc surface, and a driven roller disposed above said arc surface corresponding to said driving roller, wherein the driving member of said driving roller contacts with the film back side, and the driven member of said driving roller contacts with the film face side.

14. The film conveying device of claim 13, wherein two sets of combination of driving roller and driven roller are used, and each set is disposed oppositely across the main scanning surface.

15. The film conveying device of claim 13, wherein the driving member of said driving roller is a pair of driving wheels disposed at a specific interval on a drive shaft, and the driven member of said driven roller is a pair of driven wheels mounted on a shaft member corresponding to said driving wheels.

16. The film conveying device of claim 15, wherein the abutting surface of the driving wheels and driven wheels with the film is an arc surface.

17. The film conveying device of claim 13, wherein said driven roller is free to ascend and descend.

18. A focusing device for film density detector, being a focusing device for film density detector used in a film density detector for detecting the film density by

mounting and conveying a film on the top of a shell member formed in an arc, scanning the conveyed film surface with laser beam, and focusing the transmitted light, comprising a box-shaped main body composed of parallel ceiling member and bottom member having the longitudinal direction in the scanning direction of laser beam constituted by combining flat members, and a pair of photo detecting means disposed at proper positions on planes parallel to the scanning plane of laser beam of said main body, further forming a ceiling member contacting with the back side of a shell member on which the film of said box-shaped main body is mounted and conveyed, along the back side of said shell member, and forming a slit along the scanning direction of the laser beam for moving the laser beam forward into the main body in this ceiling member.

19. The focusing device for film density detector of claim 18 wherein said slit is covered with a scattering film for scattering the light appropriately.

20. The focusing device for film density detector of claim 18, wherein a coating is formed inside of said box-shaped main body for preventing absorption of laser beam getting into the main body.

FIG. 1

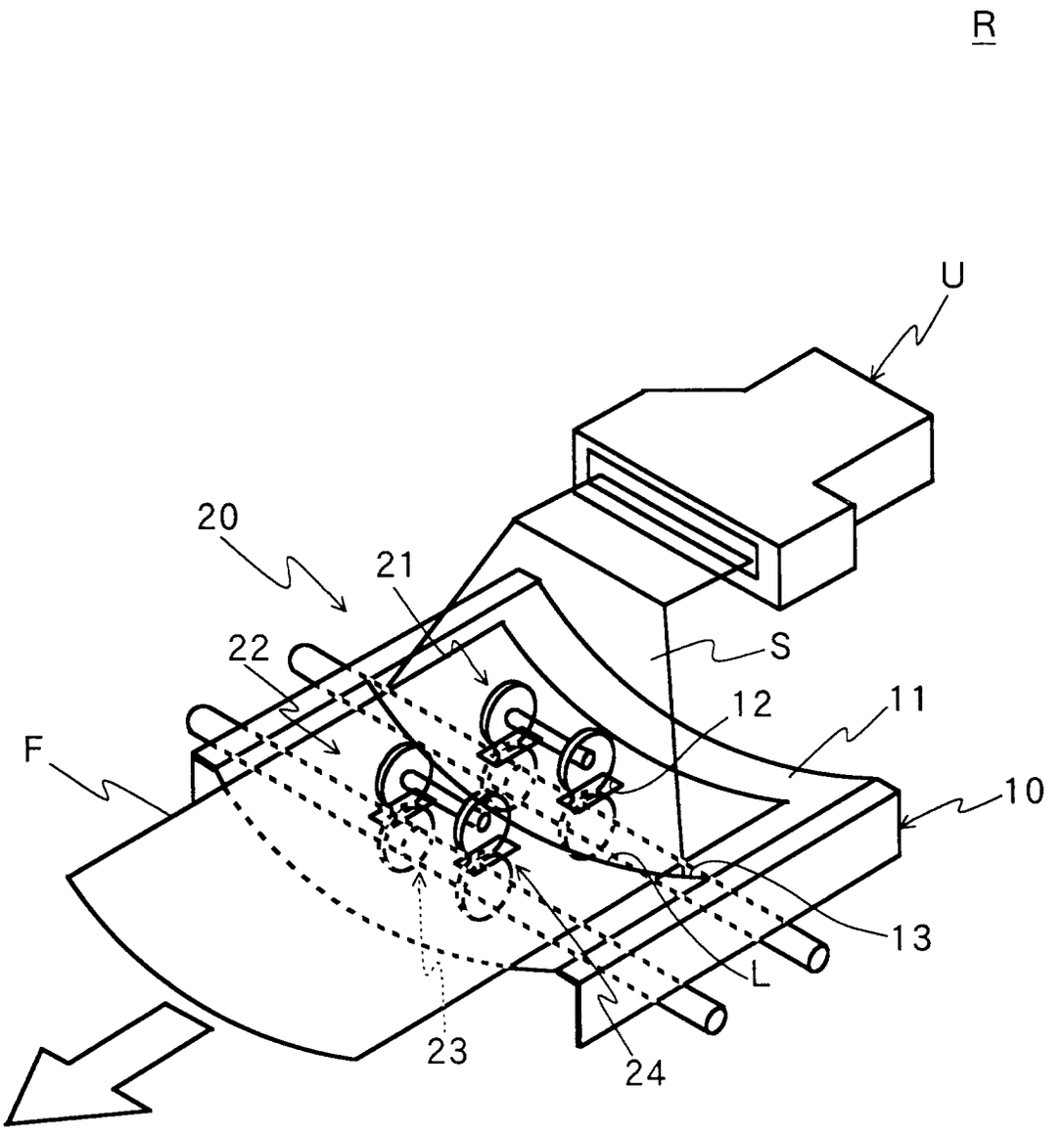
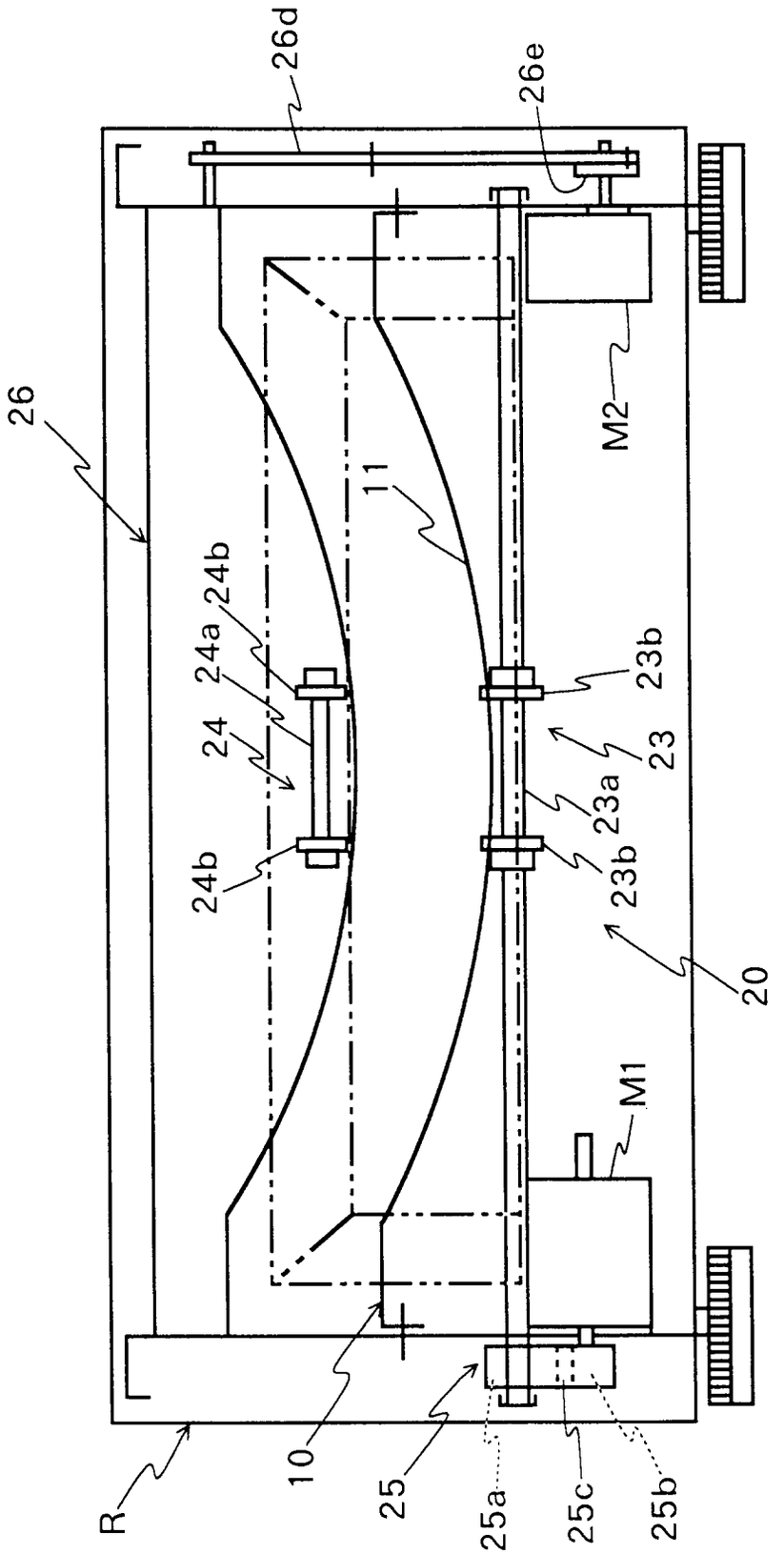


FIG. 2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M1
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25a
25c
25b
R

FIG. 3

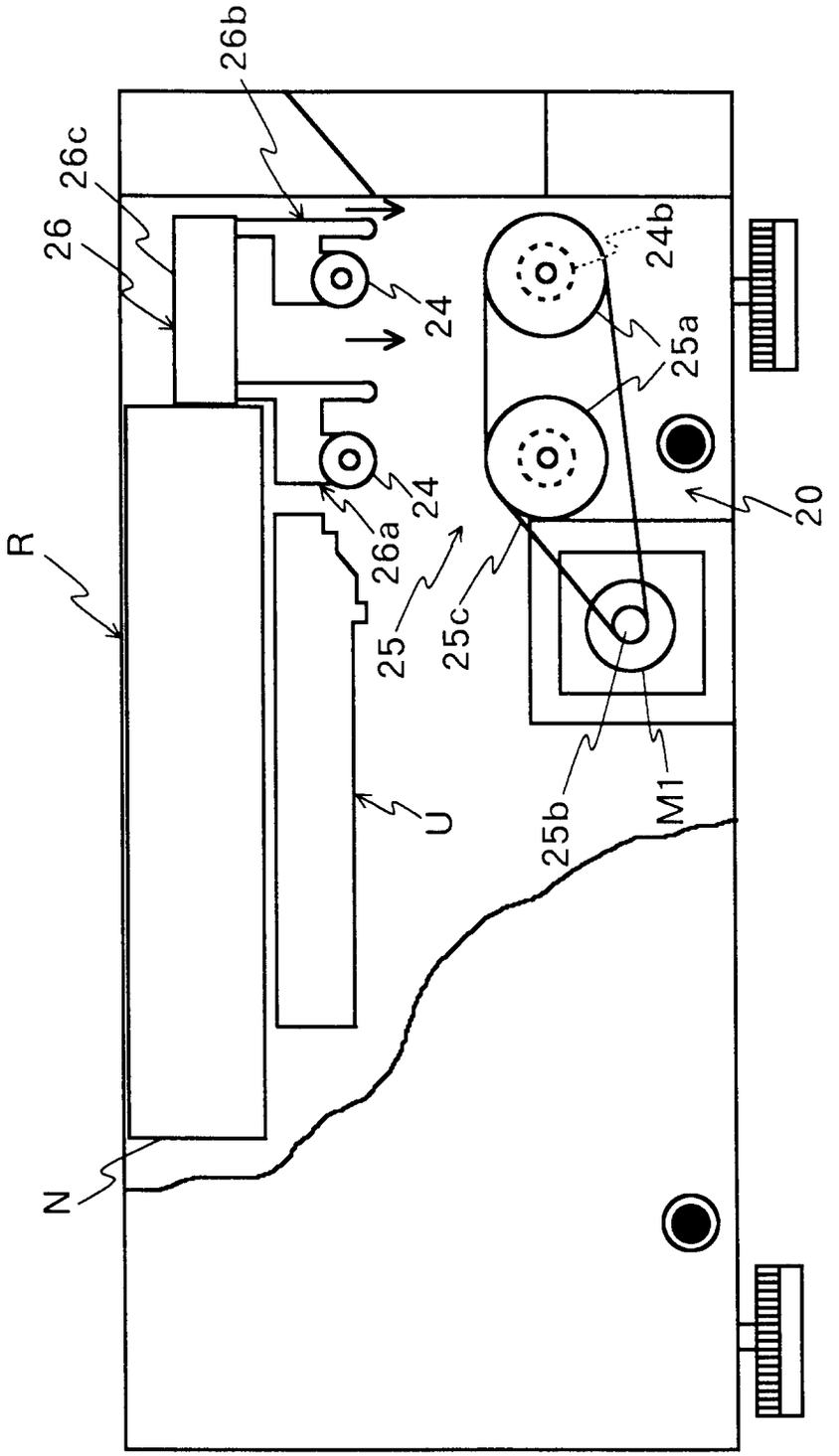


FIG. 4

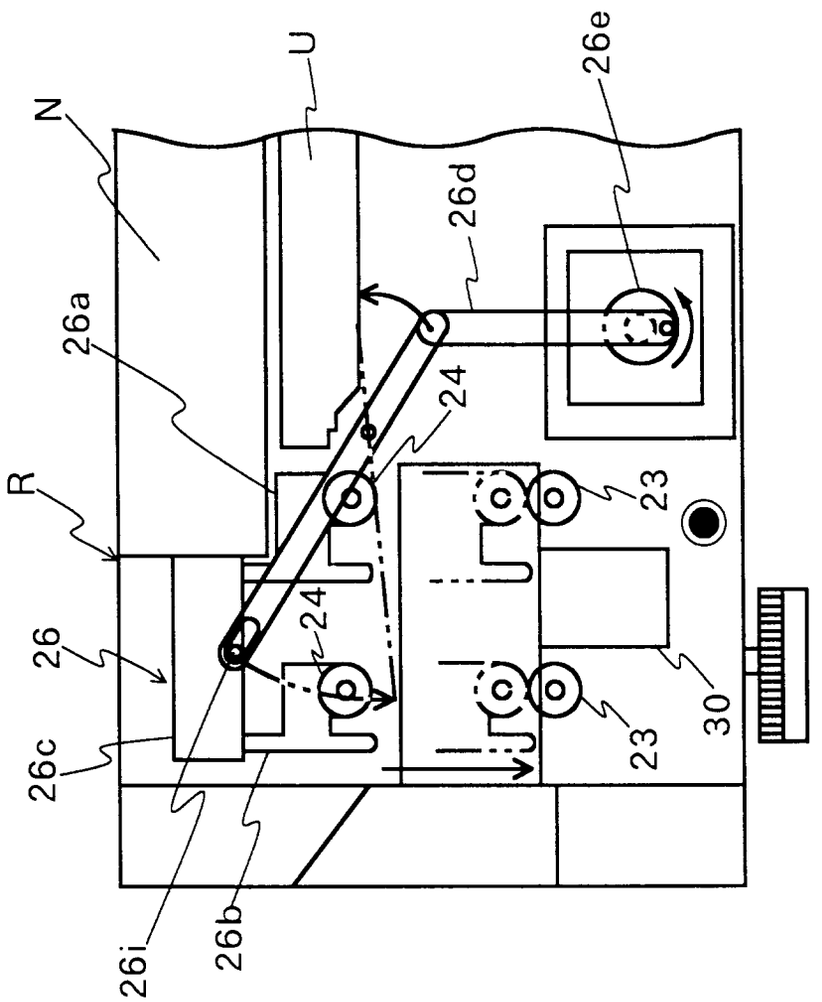


FIG. 5

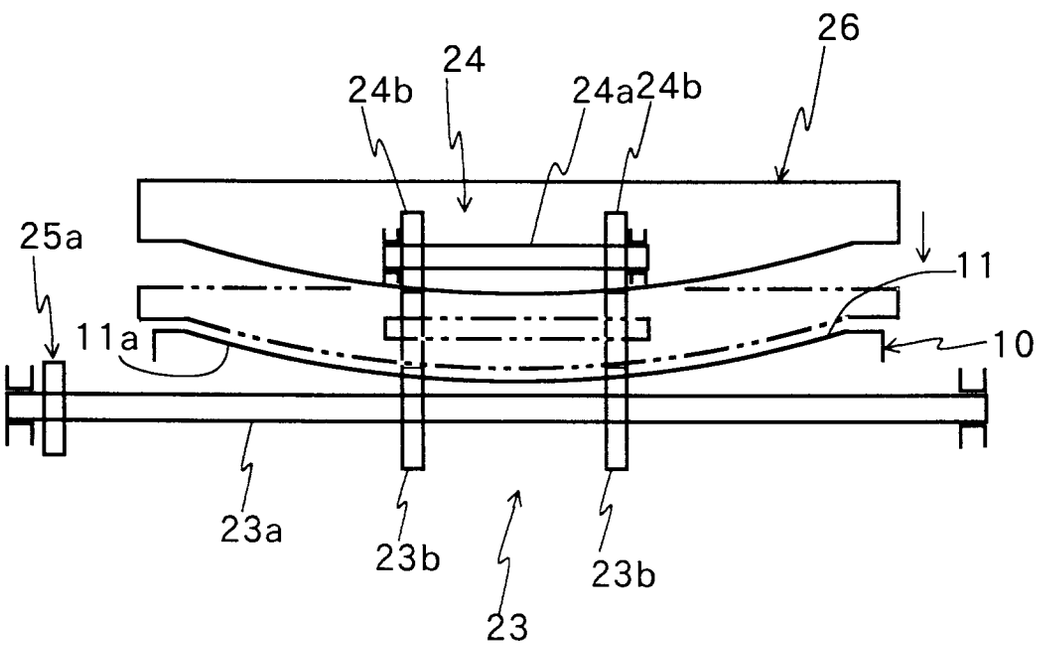


FIG. 6

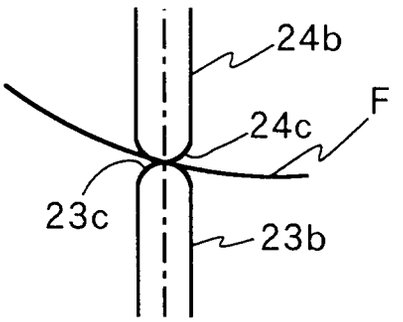
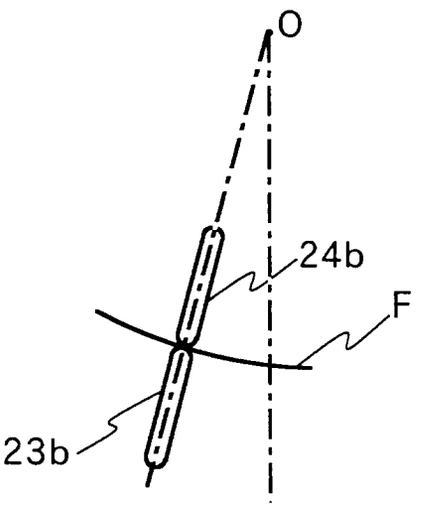


FIG. 7

(a)



(b)

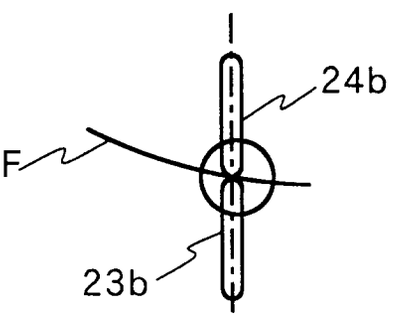


FIG. 8

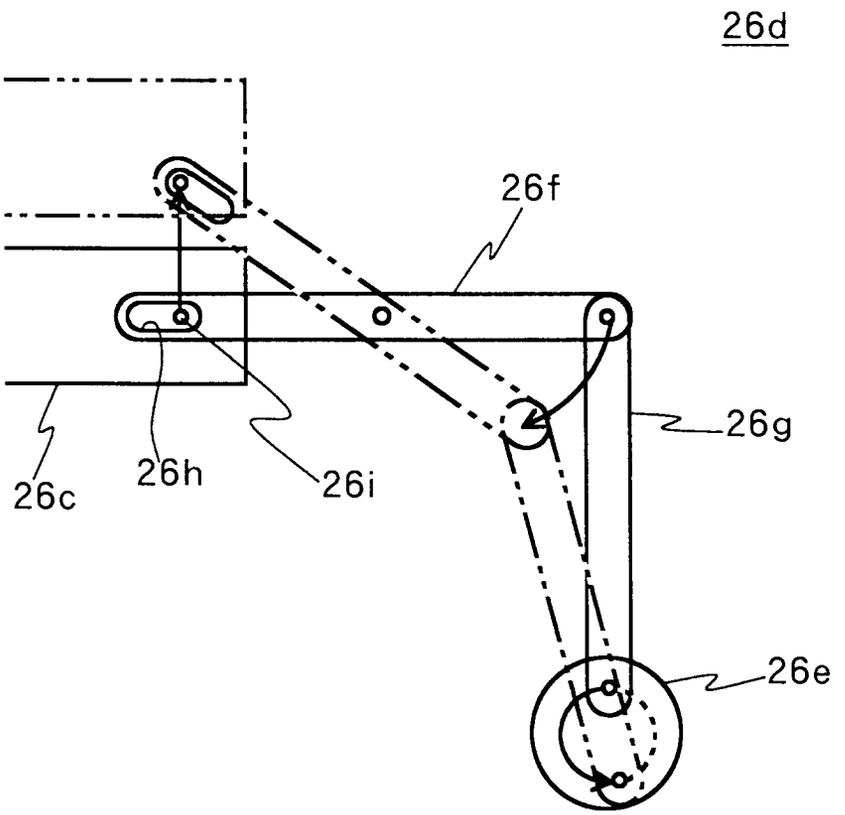


FIG. 9

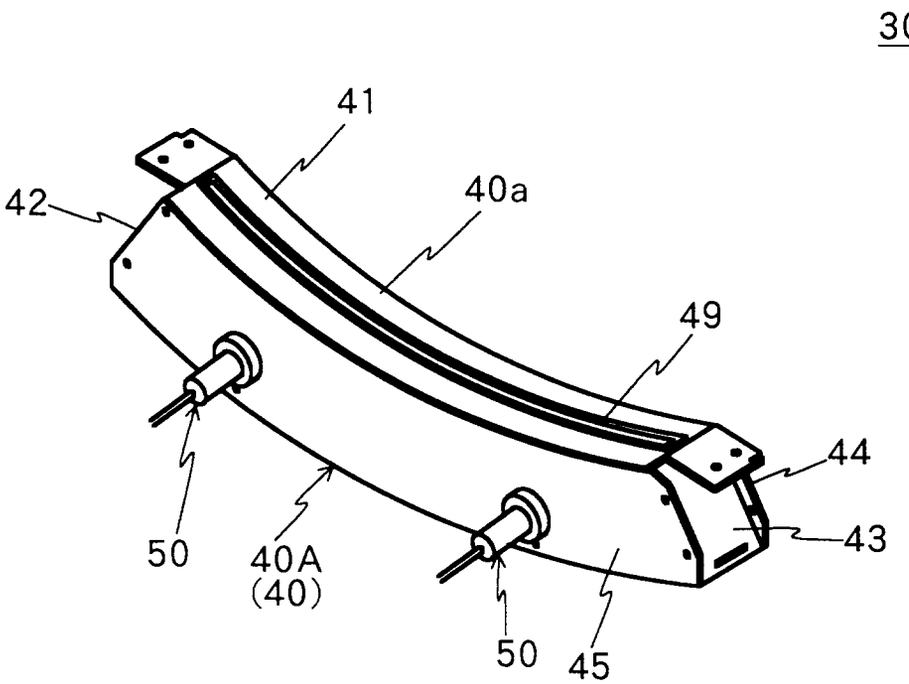


FIG. 10

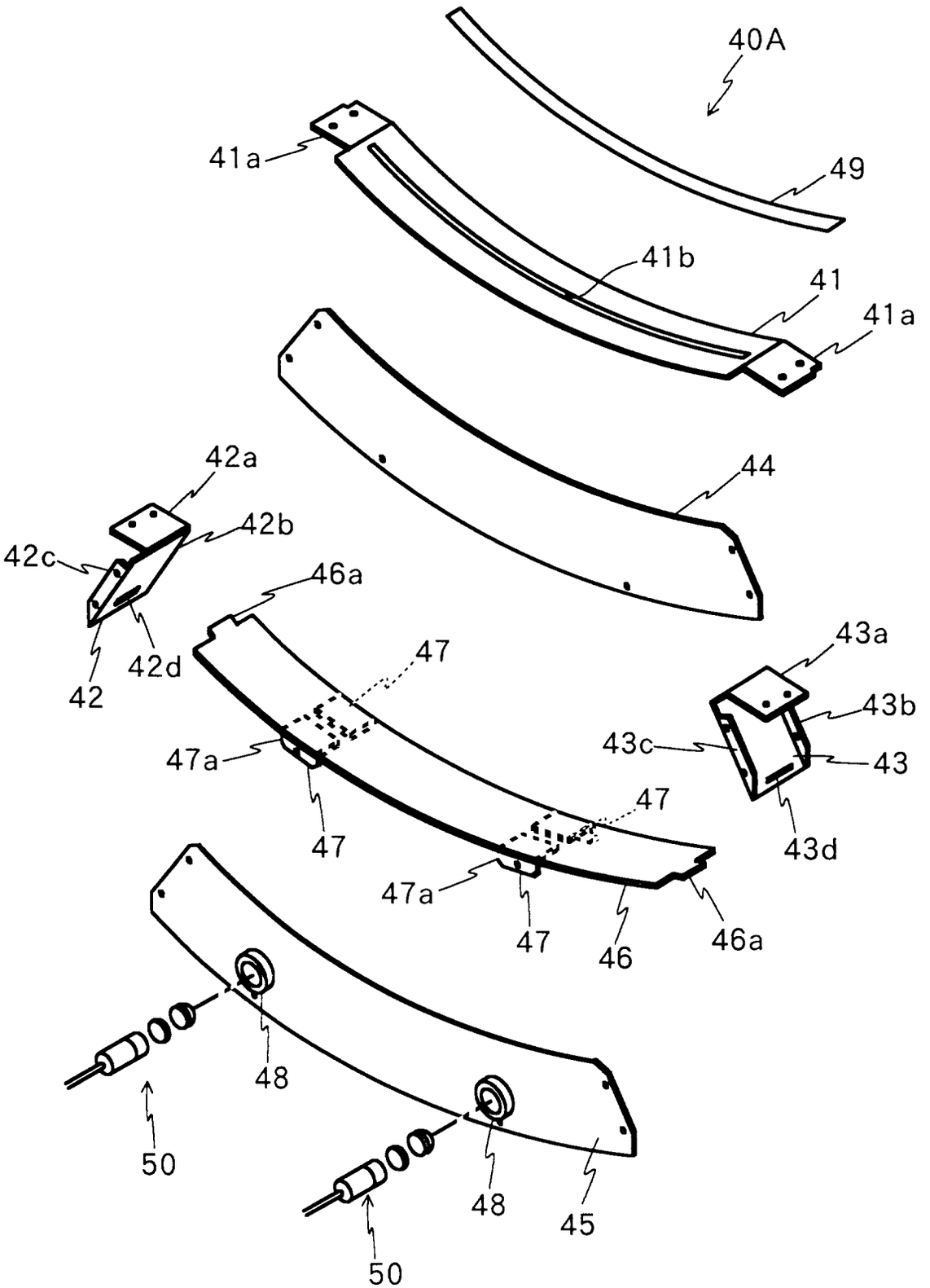

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FIG. 11

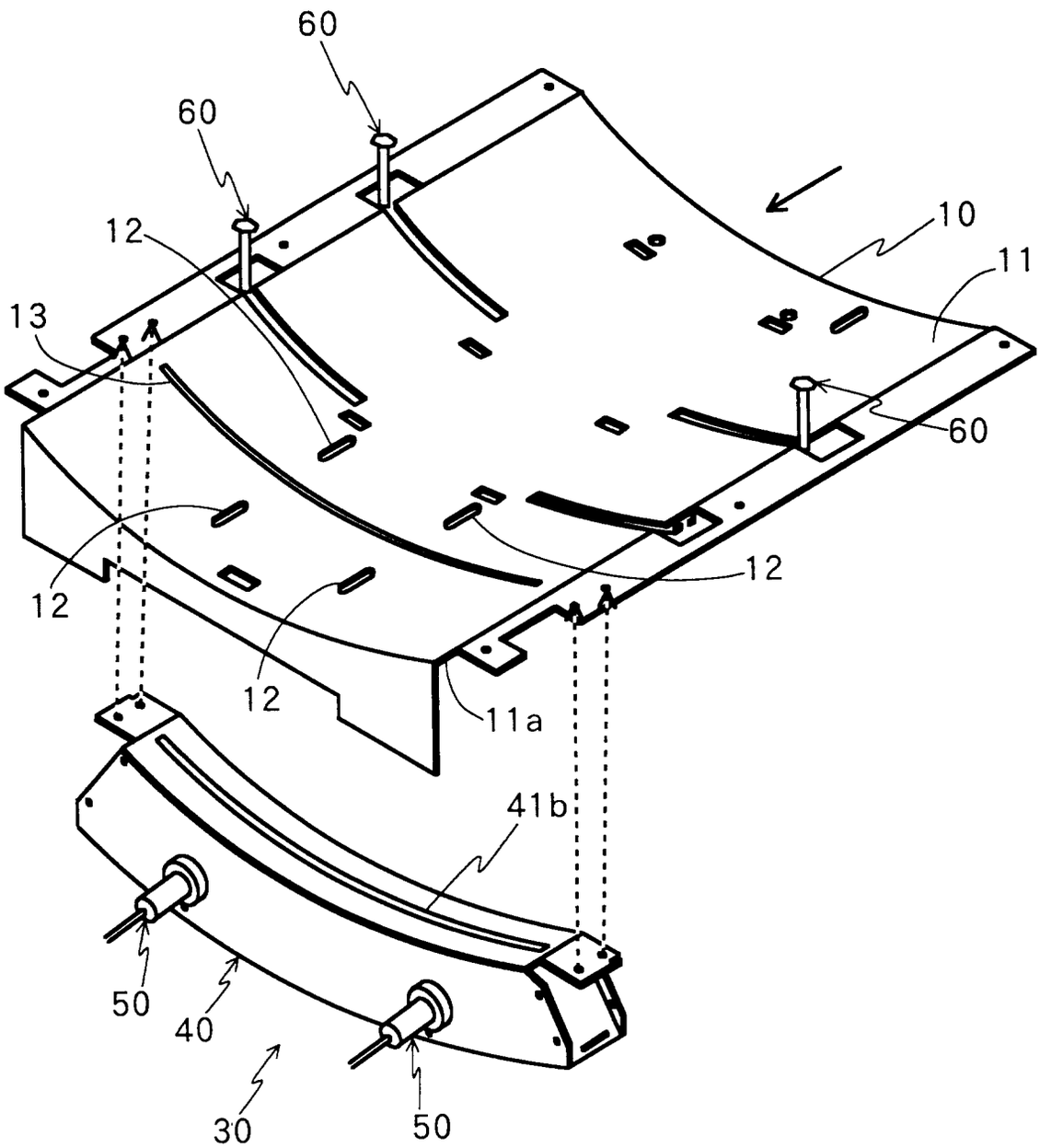


FIG. 12

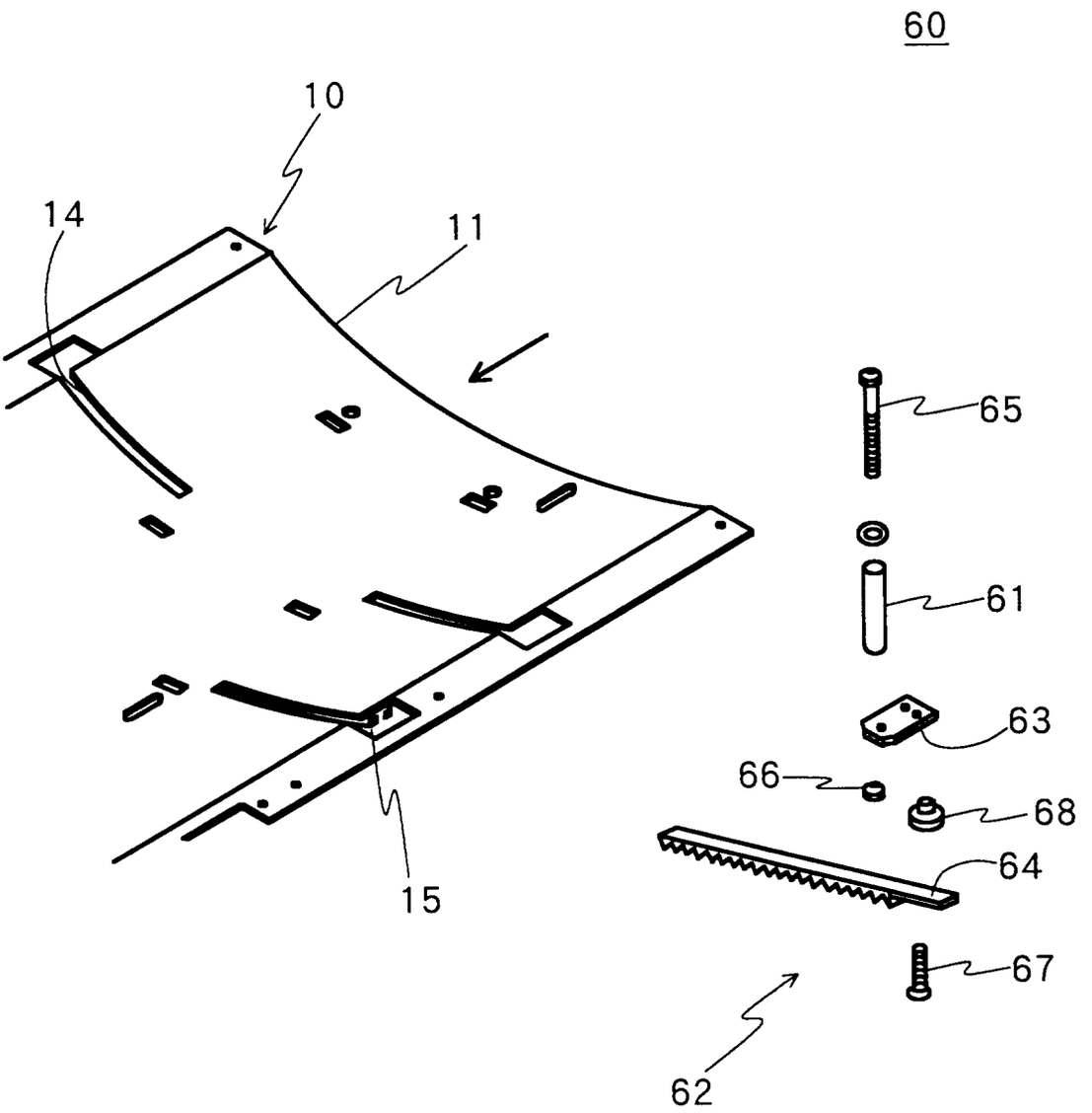


FIG. 13

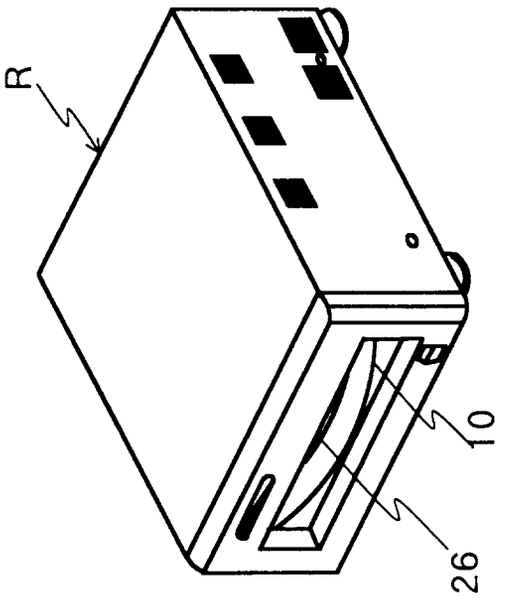


FIG. 14

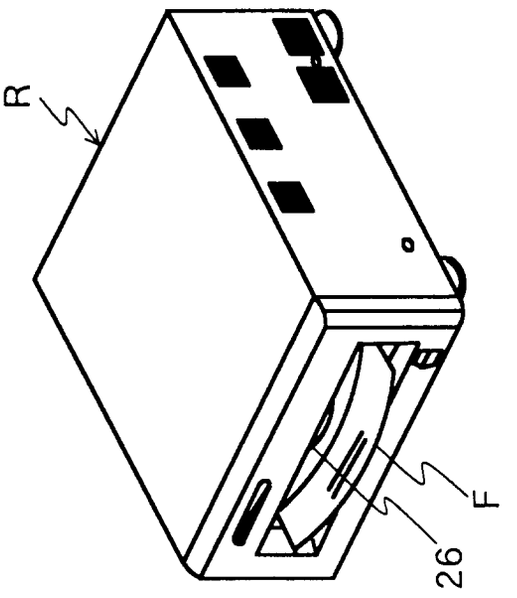


FIG. 15

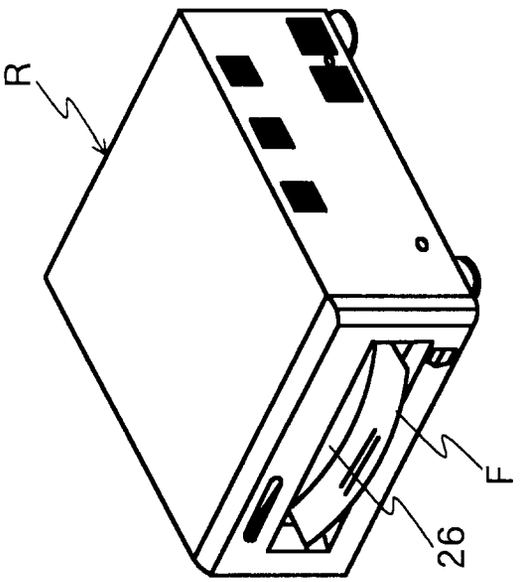


FIG. 16

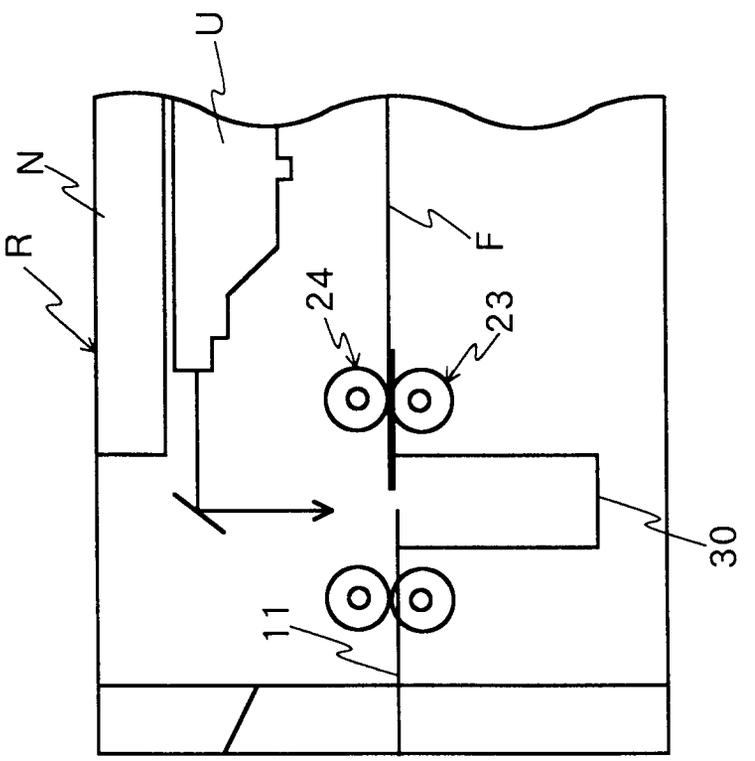


FIG. 17

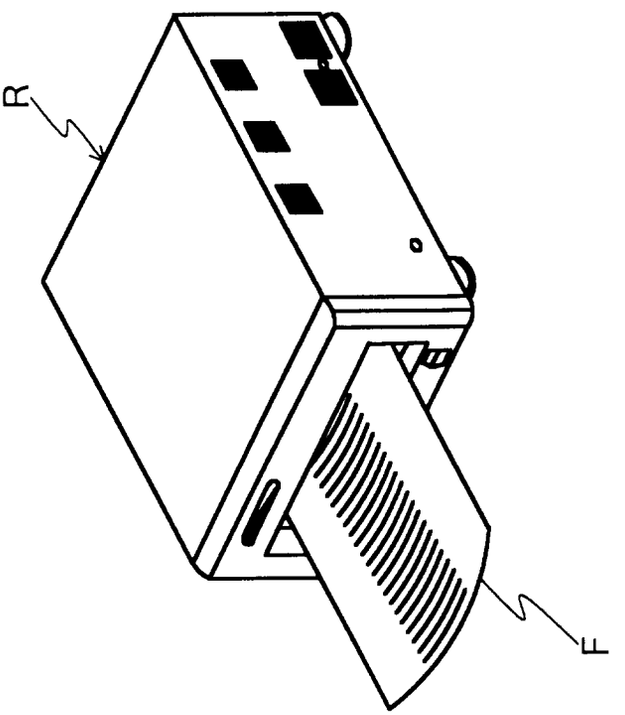


FIG. 18

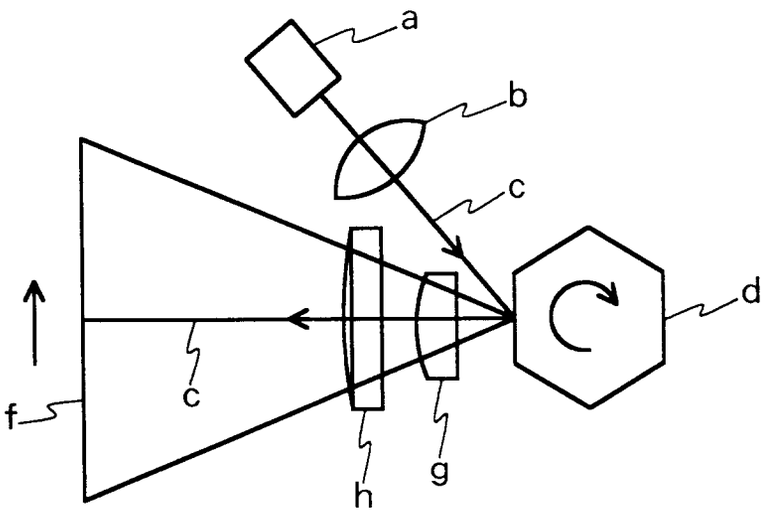


FIG. 19

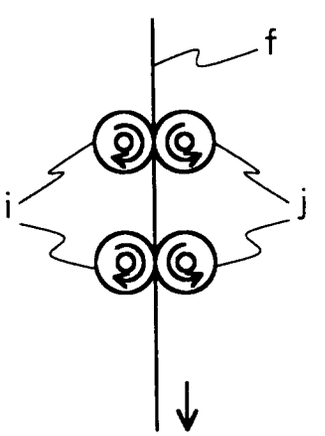


FIG. 20

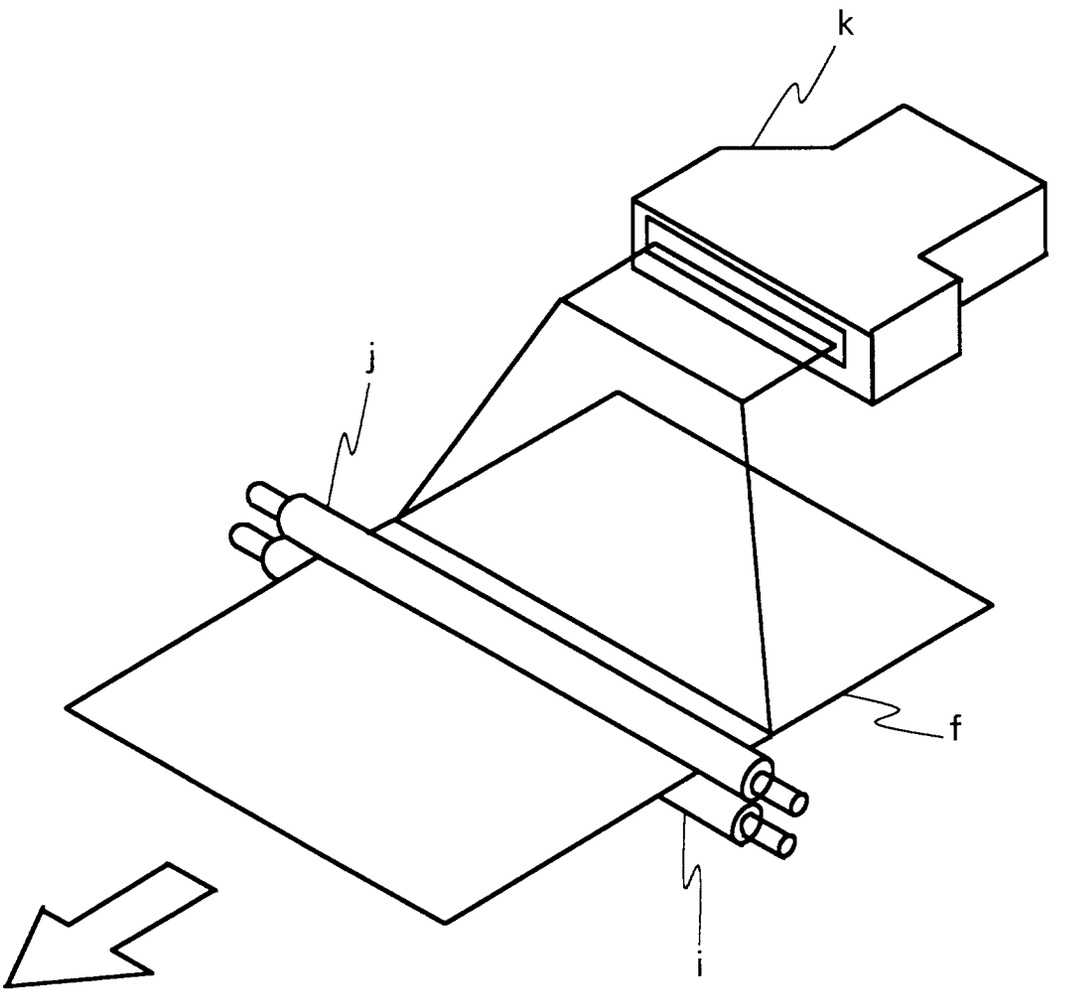
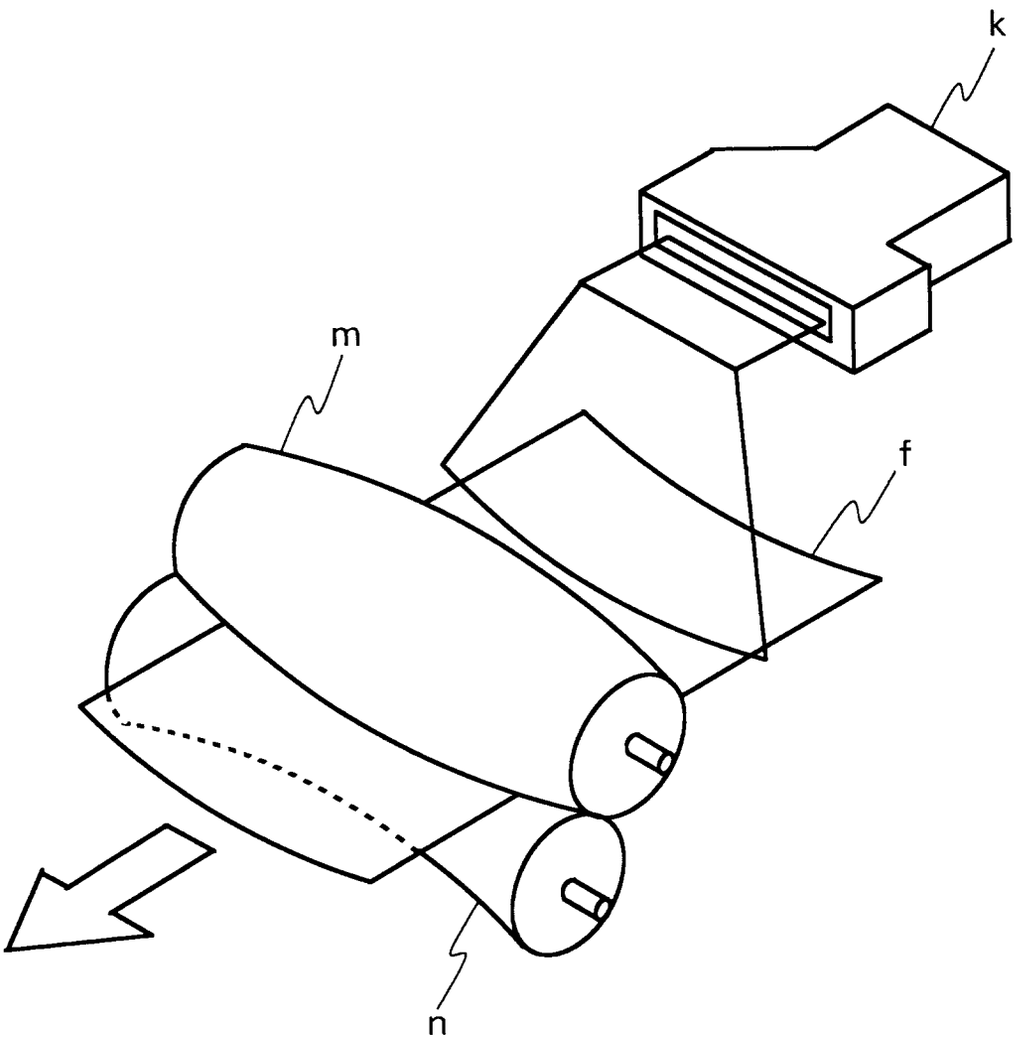


FIG. 21



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/03197

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 B65H20/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 B65H20/02, 20/06, G03G15/00, B41J15/04, H04N1/00, 1/04, 1/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926 - 1997
Kokai Jitsuyo Shinan Koho	1971 - 1997
Toroku Jitsuyo Shinan Koho	1994 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 8-2183, A (Hewlett-Packard Co.), January 9, 1996 (09. 01. 96)	1 - 20
A	JP, 3-86568, A (Canon Inc.), April 11, 1991 (11. 04. 91)(Family: none)	1 - 20
A	JP, 54-24029, A (Ricoh Co., Ltd.), February 23, 1979 (23. 02. 79)(Family: none)	1 - 20
A	JP, 6-199433, A (Canon Inc.), July 19, 1994 (19. 07. 94)(Family: none)	1 - 20
A	JP, 8-301497, A (Brother Industries, Ltd.), November 19, 1996 (19. 11. 96)	1 - 20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
December 19, 1997 (19. 12. 97)	January 7, 1998 (07. 01. 98)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)