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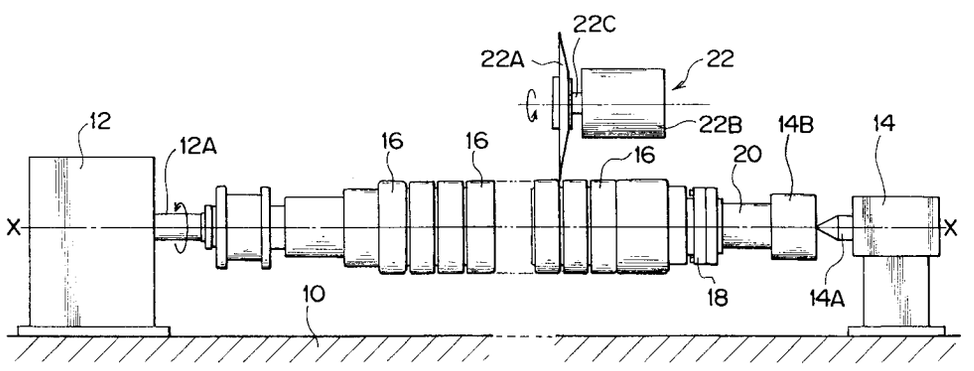
(54) Method of grinding slitting blades.

(57) In a method of grinding slitting blades, the grind accuracy can be improved and the excellent attaching accuracy can be kept, therefore, the slitting accuracy can be improved and the grind time and the grind labor can be reduced. A plurality of the circular slitting blades (16) are fastened to the common shaft (20) by the fastening device (18), and, in this state, both ends of the shaft (20) is supported with the shaft driving part (12) and the shaft cent pushing part (14) in the grind apparatus. And, the circular slitting blades (16) are successively or simultaneously ground by the cup-shaped grindstone wheel (22A) in the grindstone machine (22) of which moving values in the vertical and horizontal directions are controlled by the NC control machine. With this arrangement, a plurality of processes, which are required in the conventional method of grinding slitting blades, such as the detaching process of detaching the circular slitting blade (16) from the shaft (20), the grinding process of grinding the detached circular slitting blades (16) one by one and the attaching process of attaching them to the shaft (20) again are not needed, so that only the grinding process is required.

FIG. 1



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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method of grinding slitting blades, more particularly, to a method grinding slitting blades of a slitter which slits a broad web such as photosensitive material, magnetic record material, pressure sensitive recording paper, thermal recording paper and the like into narrow webs.

2. Description of the Related Art

A slitter which slits a broad web such as photosensitive material, magnetic recording material, pressure sensitive recording paper, thermal recording paper and the like into narrow strips is provided with upper blades 1 and lower blades 2 as shown in Fig. 11, and generally, the lower blades 2 are composed of a plurality of circular slitting blades 2 which are fastened to a shaft at predetermined intervals. When the circular slitting blade 2 is applied to the slitting for a long time, the slitting ability thereof decreases because of wear and the like, thus, a regular grind is required. And, in the conventional method of grinding slitting blades, when the circular slitting blades 2 as the lower blades are ground, first, the slitting blades 2 detached from the shaft 3 are fixed to a grind shaft 6 as shown in Fig. 12, and then outer peripheral surface buffing, rough grind and finish grind are applied to the circular slitting blades 2 one by one with a grindstone wheel 4 while rotating the grind shaft 6. Next, as shown In Fig. 13, the peripheral slitting edge 2A and the ventral slitting edge 2B of the circular slitting blade 2 are abutted to oil grindstones 5 and ground so as to have sharpness, and then attached to the shaft 3 again after inspecting the size and the tip of the blade so that the fastening state is adjusted, whereby the attaching accuracy is improved.

However, the attaching inaccuracy, in which the circular slitting blade 2 is attached to the shaft 3 of the slitter, causes the thrust deflection that the blade tip deflections in the axial direction of the shaft 3 or the radial deflection that it deflects in the rotational direction, when the broad web is slit into narrow strips. Especially, when the thrust deflection occurs, there are problems in that differences in width of the slit strip 7 are generated and the strip 7 twists and is slit, as shown in Fig. 14.

In consideration of the above-mentioned background, especially, as for the measure to improve the thrust accuracy by removing the thrust deflection in the slitting, an apparatus for fastening has been improved to fasten the ground circular slitting blade 2 to the shaft 3 accurately, as disclosed in Japan Utility Model Publication Nos. 60-1930 and 60-1931 and Japan Utility Model Application Laid -Open No. 64-52686.

However, the conventional method of grinding slitting blades, wherein a plurality of the slitting blades 2 are detached from the shaft 3 and ground one by one, and then attached to the shaft 3 again, has a disadvantage in that the attaching accuracy deteriorates. And, there is another problem in that the differences are easily generated in the grind accuracy of the respective circular slitting blades 2. That is, in a precision grind, the grind accuracy is influenced by differences in temperature of the circular slitting blade 2 and by slight contraction or expansion thereof by work environment and the like while grinding, so that the factors to deteriorate the grind accuracy may easily increase in the conventional method of grinding, wherein the circular slitting blades 2 are detached from the shaft and ground individually.

Moreover, there are disadvantages in that it takes a long time for the detaching, girding and attaching the circular slitting blade 2 is required and large labor for detaching the circular slitting blade 2 from the shaft 3 and attaching is required. Further, though the fastening apparatus has been improved, there is a problem in that high skill is needed of the worker for attaching with high accuracy whenever grinding.

SUMMARY OF THE INVENTION

This invention has been developed to eliminate the above-mentioned disadvantages and aims to provide a method of grinding slitting blades, wherein since the grind accuracy can be improved and the high accuracy for attaching can be kept, the slitting accuracy can be improved and the grind lobar and the grind time can be reduced.

To achieve the above-described aim, this invention is characterized in that a plurality of slitting blades are fastened to a common shaft through a fastening device, and, in this state, said plurality of circular slitting blades are successively or simultaneously ground by a grinding means.

According to this invention, the circular slitting blades are successively or simultaneously ground by a grinding means in the state that the circular slitting blades are fastened to a common shaft through a fastening device, therefore, a plurality of processes, which are required in the conventional method of grinding slitting blades, such as the detaching process in that the circular slitting blades are detached from the shaft, the grinding process in that the detached circular slitting blades are ground respectively and the attaching process in that the ground circular slitting blades are attached to the shaft again are not needed, so that only the

grinding process is required. With this arrangement, differences in temperature of each circular slitting blade and slight contraction or expansion thereof by work environment and the like while girding which exert the influence on the grind accuracy are not caused easily, therefore, the grind accuracy can be improved. Furthermore, the circular slitting blade does not need to be detached from the shaft and attached thereto whenever grinding, therefore, if the circular slitting blade is attached to the shaft once, the attaching accuracy remains the same every grinding, so that the attaching accuracy can be secured. Therefore, because the grind accuracy and the attaching accuracy are improved, the slitting accuracy when the broad web is slit into narrow strips can be improved.

As a result, the detaching and the attaching of the circular slitting blade are not needed, so that the amount of time can be shortened and the labor needed can be decreased.

Further, the moving value of the grinding means (in the horizontal direction) is detected by the detecting means and fed back to the NC controller which controls the grinding means, therefore, the constant grind accuracy can be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

The exact nature of this invention, as well as other aims and advantages thereof, will be readily apparent from the consideration of the following specification relating to the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof and wherein:

Fig. 1 is a schematic view in that the shaft fastened with a plurality of the circular slitting blades is supported by the grinding apparatus used for the method of grinding slitting blades according to this invention;

Fig. 2 is an explanary view for explaining the moving track of the grindstone machine in the method of grinding slitting blades according to this invention;

Fig. 3 is a fragmentary sectional view showing the grinding state in the method of grinding slitting blades according to this invention;

Fig. 4 is a fragmentary sectional view showing the sharpening by the method of grinding slitting blades according to this invention;

Figs. 5(A), 5(B) and 5(C) show the performance which is measured and plotted grinding accuracy of the slitting blade ground by the invention;

Fig. 6(A), 6(B) and 6(C) show the performance which is measured and plotted grinding accuracy according to conventional method of grinding slitting blades;

Fig. 7 shows the performance which is measured and plotted the thrust accuracy in the method of grinding slitting blades according to this invention;

Fig. 8 shows the performance which is measured and plotted the thrust accuracy in the conventional method of grinding slitting blades;

Fig. 9 shows the performance which is measured and plotted the slitting accuracy in the method of grinding slitting blades according to this invention;

Fig. 10 shows the performance which is measured and plotted the slitting accuracy in the conventional method of grinding slitting blades;

Fig. 11 is a fragmentary sectional view showing the construction of the upper and lower blades in the slitter;

Fig. 12 is a fragmentary sectional view showing the outline of the grind by the conventional method of grinding slitting blade;

Fig. 13 is a fragmentary sectional view showing the sharpening by the conventional method of grinding slitting blades; and

Fig. 14 is a state view showing the slitting state of the web in the case that the thrust accuracy is bad.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Detail description will hereunder be given of the preferred embodiment of the method of grinding slitting blades according to this invention with reference to the accompanying drawings.

Fig. 1 shows the grinding apparatus used for the method of the grinding slitting blades according to this invention.

As shown in Fig. 1, a shaft driving part 12 is located on one side of a horizontal base 10 and a shaft center pushing part 14 is provided on the other side thereof. A plurality of circular slitting blades 16, 16... to be ground are put on the shaft 20 and fastened by the fastening device 18. And, both ends of the shaft 20 provided with the circular slitting blades 16 is supported so that may have the rotational center line shown with X-X in Fig. 1 by which the shaft driving part 12 and the shaft center pushing part 14 are linked. Moreover, the shaft driving part 12 has a built-in motor and a driving axis is rotated thereby, so that the shaft 20 is rotated at a predetermined rotating speed. Further, the shaft center pushing part 14 mainly consists of a center 14A projecting to the side of the shaft driving part 12 and a shaft bearing 14B located at the head of the center 14A to bearing-support one end of the shaft 20.

A grindstone machine 22 is arranged above the shaft 20 supported by the shaft driving part 12 and the shaft center pushing part 14, and it is composed of a grindstone driving part 22B having a built-in motor, a grindstone axis 22C rotated at a predetermined rotating speed by the motor and a cup-shaped grindstone wheel 22A attached to the head of the grindstone axis 22C. Moreover, the grindstone machine 22 moves for a predetermined moving value intermittently in the vertical and horizontal directions as shown by ①-⑬ in Fig. 2 by the NC control mechanism not shown. Especially, the moving value in the horizontal direction which exerts a great influence on the grinding accuracy is detected by the magnetic digital read out system and fed back to the NC control mechanism.

And, the NC control mechanism controls the angle α of the grindstone machine 22, so that the cup-shaped grindstone wheel 22A and the ventral slitting edge end 16A of the circular slitting blade 16 may be abutted to have a predetermined angle. Further, CBN grindstone 22D (grindstone which cubic boron nitride grains are united with the binder) clings on the peripheral portion on the grind surface of the cup-shaped grindstone wheel 22A, and is abutted to the vertical slitting edge end 16A of the circular slitting blade 16 to thereby grind.

Next, the explanation will be given of the method of grinding slitting blade according to this invention using the grinding apparatus constructed like the above-mentioned, that is, the method of grinding the circular slitting blade 16 attached to the shaft 20.

First, the shaft 20 is detached from the slitter, not shown, in the state that the circular slitting blade 16 is fixed thereto, a end of the shaft 20 is supported at the shaft driving part 12 and the other end is supported with the shaft bearing 14B in the shaft center pushing part 14. And, the motor in the shaft driving part 12 is operated to thereby rotate the circular slitting blade at the predetermined rotating speed. Next, the grindstone motor of the grindstone machine 22 is operated to thereby rotate the cup-shaped grindstone 22A at the predetermined rotating speed. Then, the grindstone machine 22 is controlled by the NC control mechanism and the following operations are performed, whereby the circular slitting blades 16 are ground one by one successively. That is, the grindstone machine 22 moves downward as ① in Fig. 2 by the predetermined moving value, and the CNB grindstone 22D of the cup-shaped grindstone wheel 22A enters between the circular slitting edges 12 put on at the predetermined intervals. Then, the grindstone machine 22 moves in the axial direction of the shaft 20 as ② in Fig. 2 by the predetermined moving value, and as shown in Fig. 3, the CBN grindstone 22D of the cup-shaped grindstone wheel 22A is abutted to the vertical slitting edge end 16A of the circular slitting blade 16 to thereby grind the vertical slitting edge end 16A for at the predetermined time. When the grind is completed, the grindstone machine moves as ③ and ④ in Fig. 2 in the axial direction of the shaft 20 by the predetermined moving value so as to be apart from the vertical slitting edge end 16A, and then moves upward so that the cup-shaped grindstone wheel 22A is retracted from between the circular slitting blades 16. As shown in Fig. 4, the oil grindstone 24 is abutted flatly to the outer peripheral edge end 16B of the circular slitting blade 16 to thereby sharpen it and then synchronizing the cup-shaped which is retracted from between the circular slitting blades 16. Therefore, the grind of one circular slitting blade 16 is completed, and the grindstone machine 22 moves as ⑤-⑨ in Fig. 2 to thereby grind the next circular slitting blade 16 similarly.

According to the method of grinding slitting blades of this invention, the grindstone machine 22 is moved on the predetermined route for the predetermined moving value by the NC control mechanism in the state that a plurality of the circular slitting blades 16 are attached to the shaft 20, whereby the circular slitting blades 16 can be ground successively, therefore, a plurality of processes in which the circular slitting blade 16 is detached from the shaft 20, the detached circular slitting blade 16 is ground individually and then attached to the shaft 20 again, as in the conventional method of grinding slitting blades, are not required, so that the grind can be performed at once. With this arrangement, differences in temperature of each circular slitting blade 16 and slight contraction or expansion thereof by work environment and the like while girding which exert influence on the grind accuracy are not easily caused, therefore, the grind accuracy can be improved. Furthermore, in the method of girding slitting blades according to this invention, there is no need that the circular slitting blade 16 is detached from the shaft every grind and attached thereto, therefore, if the circular slitting blade is attached to the shaft once, no difference of the attaching accuracy generates every grinding, so that the excellent attaching accuracy can be secured. Therefore, because the grind accuracy and the attaching accuracy are improved, the slitting accuracy when the broad web is slit into narrow webs can be improved.

Moreover, in the method of grinding slitting blades according to this invention, the detaching and the attaching of the circular slitting blade are not needed, so that the amount of time can be shortened and the labor needed can be decreased.

Next, the explanation will be given of the result that this invention is compared with the conventional method of grinding in which the slitting blade is detached and ground concerning the grind accuracy, the attaching accuracy which is measured by the thrust accuracy and the slitting accuracy while girding the circular slitting blade.

Figs. 5(A), 5(B) and 5(C) show the grind accuracy measured with the tracer-type roughness meter when the circular slitting blade 16 is ground by the method of grinding slitting blades according to this invention, and Fig. 5(A) shows the performance of the shape of the outer peripheral edge end 16B in the circular slitting blade 16, Fig. 5(B) shows the performance of the shape of the vertical edge end 16A in the circular slitting blade 16 and Fig. 5(C) shows the performance of the roughness of the vertical edge end 16A. Moreover, Figs. 6(A), 6(B) and 6(C) show the performance of the circular slitting blade 16 ground by the conventional method of grinding and corresponding to Figs. 5(A), 5-(B) and 5(C). The differences can be recognized apparently from Figs. 5 and 6, that is, the outer peripheral edge end 16B and the vertical edge end 16A are ground to have sharp shapes in the method of grinding according to this invention, however, dullness is generated by the conventional method of grinding, particularly, at the vertical edge end 16A.

Moreover, the roughness on the grind surface of the vertical slitting edge end 16A is within 0.6μm in the method of grinding according to this invention, however, the maximum difference is 6μm in the conventional method of grinding.

Fig. 7 shows the performance of the thrust accuracy of the circular slitting blade 16 (the deflection in the axial direction of the shaft 20) which is measured in the state the shaft 20 is attached to the slitter and rotated at the predetermined rotating speed after girding according to the method of girding slitting blade of this invention. Moreover, Fig. 8 shows the performance of the thrust accuracy which is similarly measured in the state that the shaft 20 is attached to the slitter after girding according to the conventional method of girding and attaching the circular slitting blade 16 to the shaft 20. The difference can be recognized apparently from Figs. 7 and 8, that is, the thrust accuracy is within 2μm in the method of grinding according to this invention, however, the maximum difference is 10μm in the conventional method of grinding.

Fig. 9 shows the performance of the slitting accuracy (the strip width accuracy slit) which is measured by the laser continuous width measuring machine when the broad web is slit into narrow strips in the state that the shaft 20 is attached to the slitter after grinding according to the method of grinding slitting blade of this invention. Moreover, Fig. 10 is a measurement view showing the slitting accuracy which is similarly measured in the state that the shaft 20 is attached to the slitter after grinding according to the conventional method of grinding slitting blade and attaching the circular slitting blade 16 to the shaft 20. The difference can be recognized apparently from Figs. 9 and 10, that is, as for the slitting accuracy, the differences of the strip width accuracy is within 5μm in the method of grinding according to this invention, however, the maximum difference is 12μm in the conventional method of grinding.

As has been described hereinabove, according to the method of girding slitting blades of this invention, the grind accuracy can be improved in comparison with the conventional method of girding and the excellent attaching accuracy can be kept, therefore, the slitting accuracy can be improved. Therefore, when the web to be slit is a cinefilm, the projection screen can be improved so as to reduce the horizontal deflections.

Moreover, in this embodiment, the description has been given of grinding the lower blade (circular slitting blade) which composes of the slitter with the upper blade, however, this invention should be not limited to this, and may be applied to the upper blade. Further, in this embodiment, one cup-shaped grindstone wheel is attached to the grindstone machine and a plurality of circular slitting blades are ground successively, however, this invention should be not limited to this, a plurality of cup-shaped grindstone wheels may be attached to the grindstone axis of the grindstone machine so as to grind a plurality of circular slitting blades simultaneously. Moreover, in this embodiment, the movement of the grindstone machine is controlled by the NC control mechanism, however, a heed handle and the like may be used.

As has been described hereinbefore, in the method of grinding slitting blade according to this invention, the circular slitting blades are successively or simultaneously ground by the grinding means in the state that the circular slitting blades are fasten to the fastening device, therefore, the grind accuracy can be improved and the excellent attaching accuracy which the circular slitting blades are attached once can be kept, therefore, the slitting accuracy can be improved. Moreover, in the method of grinding slitting blades according to this invention, is not necessary to detach the circular slitting blades from the shaft and attach them thereto, therefore, the amount of time needed can be shortened and the labor needed can be decreased.

It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the invention

is to cover all modifications, alternate constructions and equivalents falling within the spirit and scope of the invention as expressed in the appended.

Claims

1. A method of grinding slitting blades (16), wherein circular slitting blades (16) are ground, characterized in that a plurality of circular slitting blades (16) are fastened to a common shaft (20) by a fastening device (18), and, in this state, said plurality of circular slitting blades (16) are successively or simultaneously ground by a grinding means (22).

2. A method of grinding slitting blades (16) as set forth in claim 1, wherein said blades (16) are successively ground while said grinding means (22) repeats intermittent movements in horizontal and vertical directions.

3. A method of grinding slitting blades (16) as set forth in claim 1, wherein said grinding means (22) is constructed such that grind stones (22D) equal in number to said circular slitting blades (16) are arranged in parallel, and the plurality of circular slitting blades are ground simultaneously.

4. A method of grinding slitting blades (16) as set forth in claim 1, wherein the intermittent movements of said grinding means (22) in the horizontal and vertical directions are controlled by a NC (numerically control) machine.

5. A method of grinding slitting blades (16) as set forth in claim 4, wherein a detecting means for detecting a movement value of said grinding means (22) in the horizontal direction is provided, and the result detected by said detecting means is fed back to said NC machine.

6. A method of grinding slitting blades (16) as set forth in claim 5, wherein said detecting means is a magnetic digital read out system.

FIG. 1

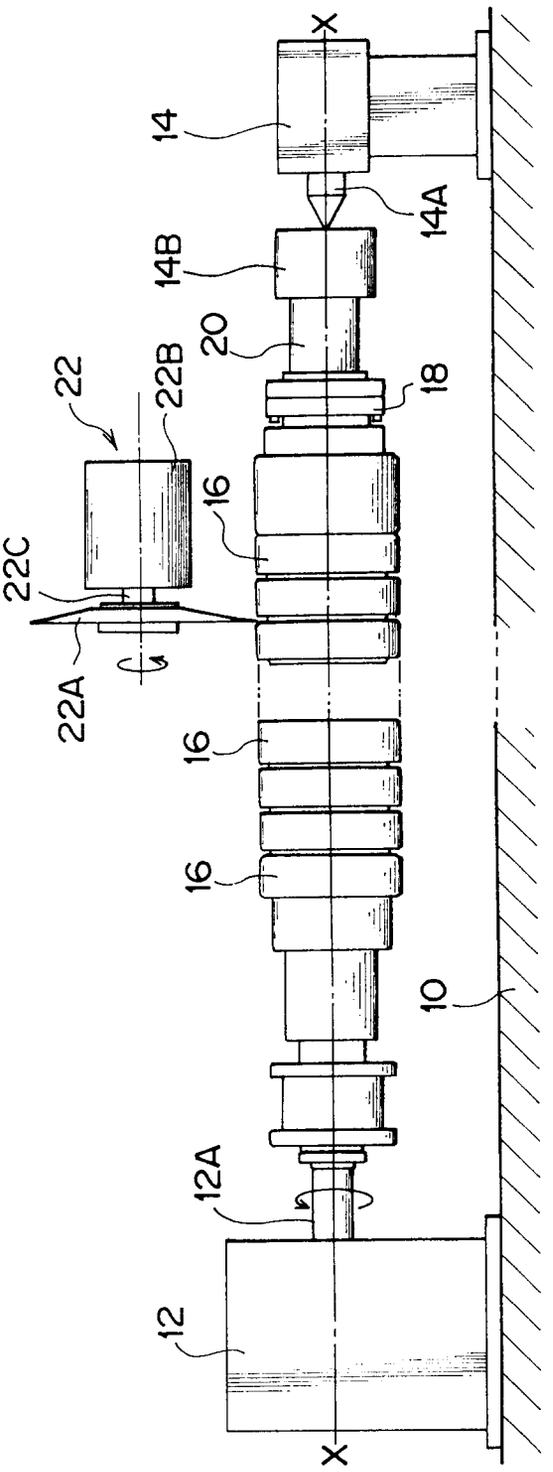


FIG. 2

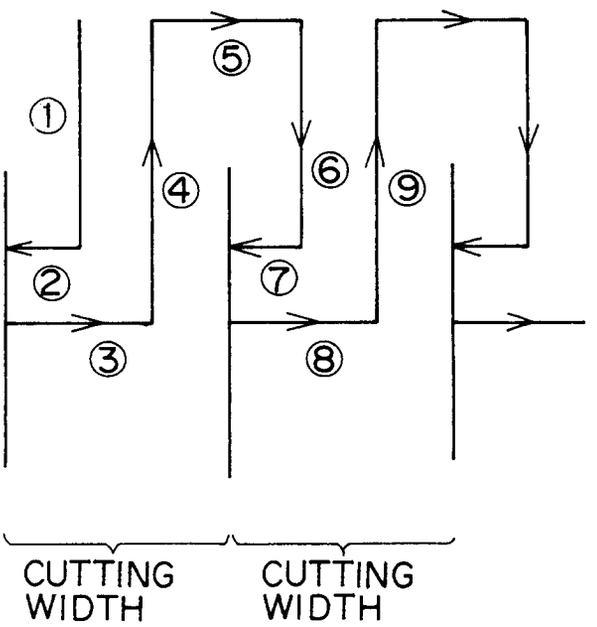


FIG.3

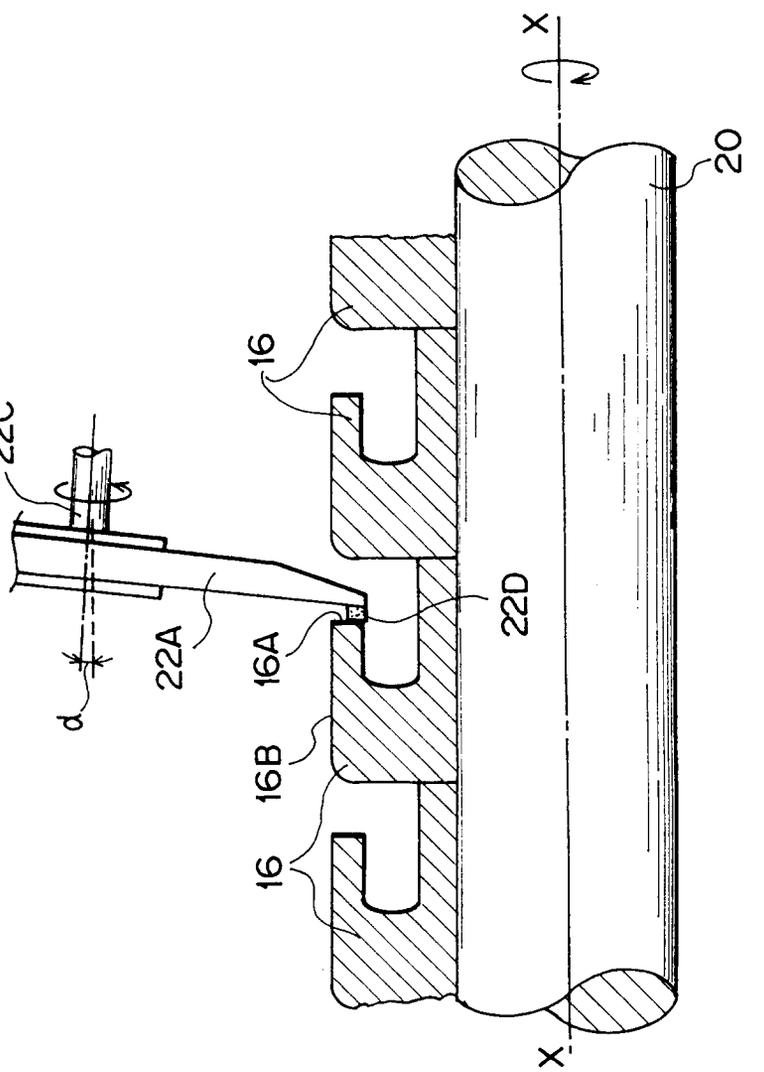
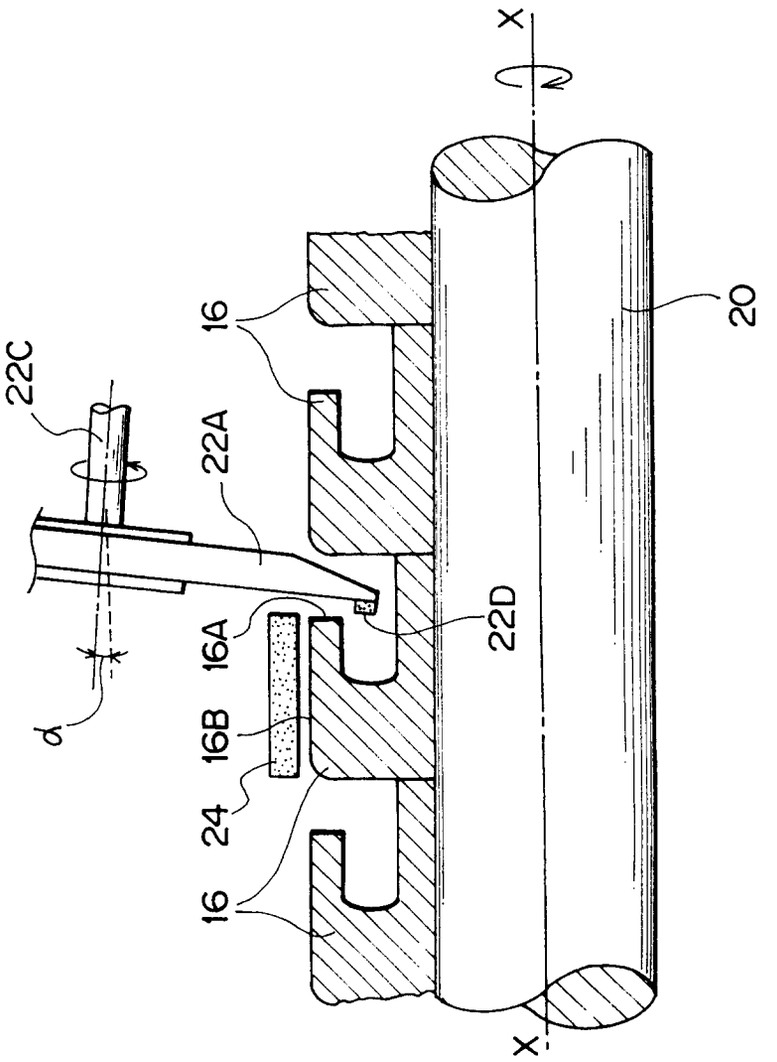
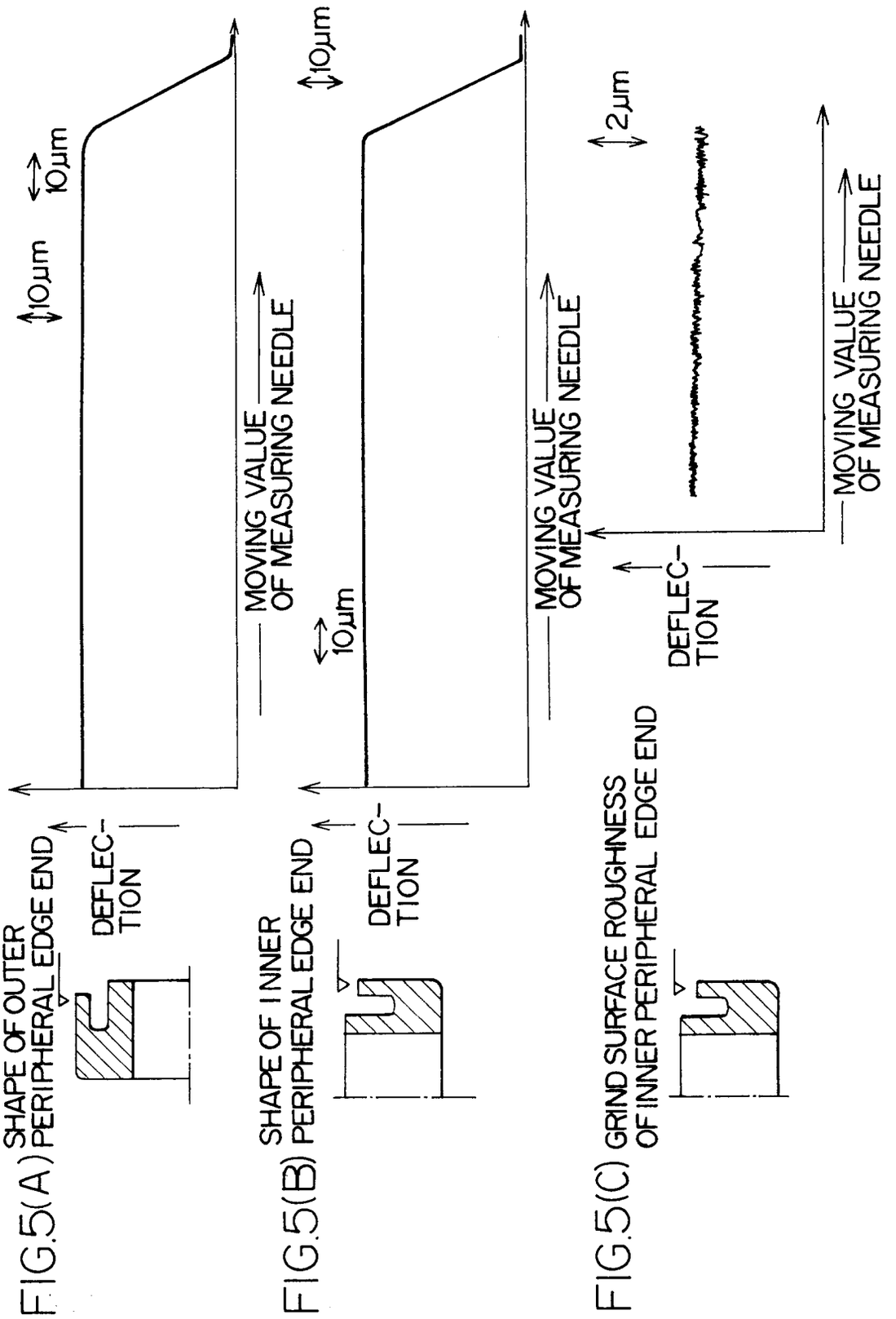


FIG.4




SHAPE OF OUTER PERIPHERAL EDGE END
DEFLEC-TION
10μm
10μm
MOVING VALUE OF MEASURING NEEDLE
FIG.5(A)
SHAPE OF INNER PERIPHERAL EDGE END
DEFLEC-TION
10μm
10μm
MOVING VALUE OF MEASURING NEEDLE
FIG.5(B)
GRIND SURFACE ROUGHNESS OF INNER PERIPHERAL EDGE END
DEFLEC-TION
2μm
MOVING VALUE OF MEASURING NEEDLE
FIG.5(C)

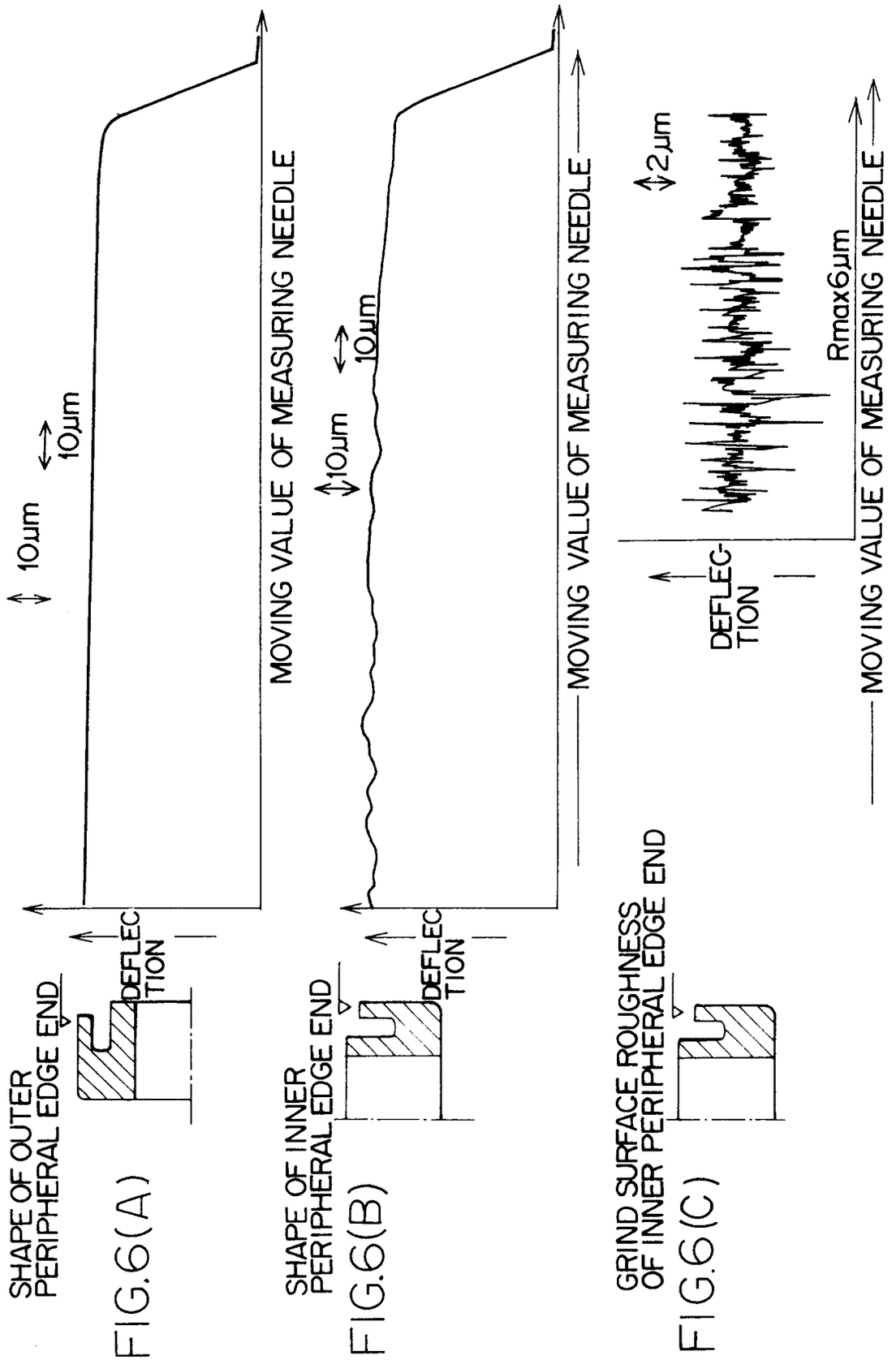


FIG.6(A)

FIG.6(B)

FIG.6(C)

FIG. 7

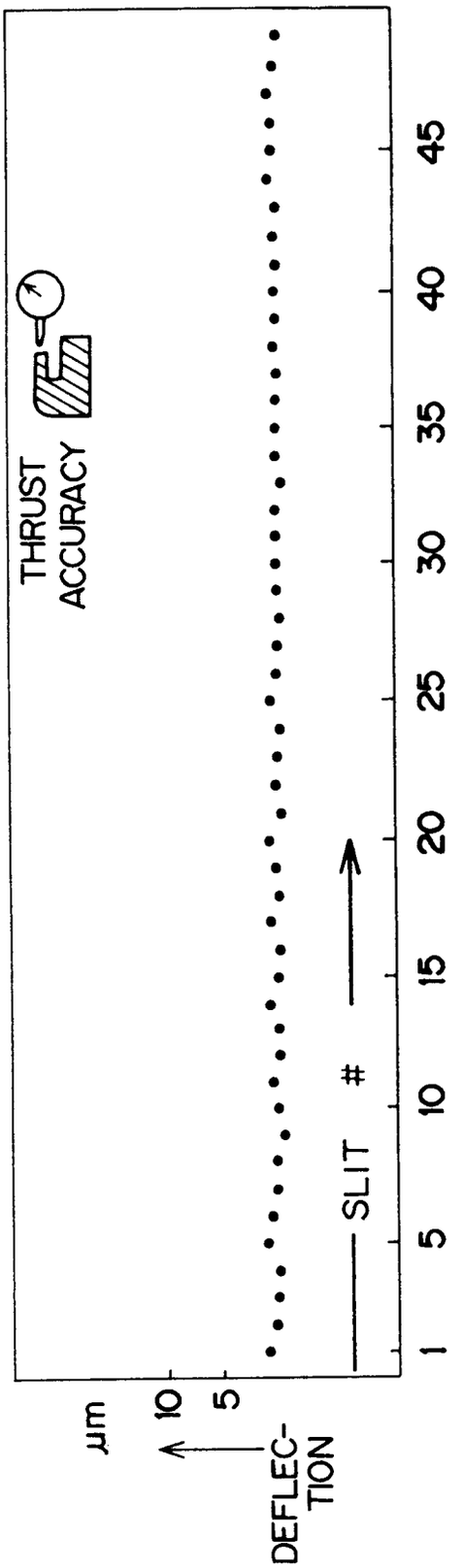

THRUST
ACCURACY
DEFLEC-
TION
μm
10
5
SLIT #
1
5
10
15
20
25
30
35
40
45

FIG.8

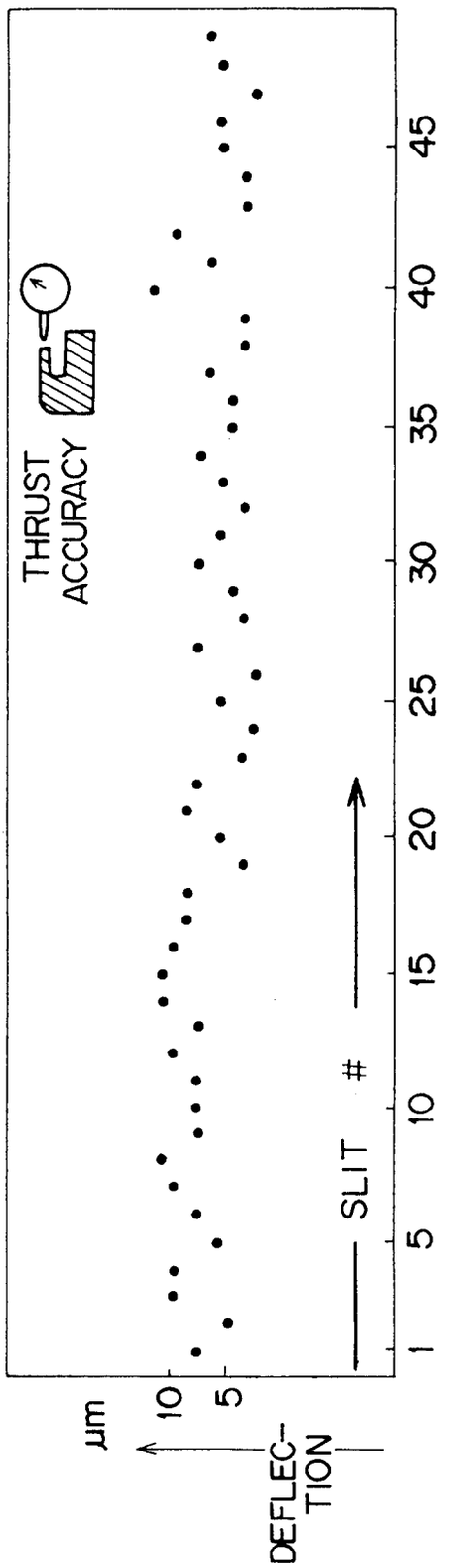

THRUST ACCURACY
DEFLEC-TION
μm
10
5
SLIT #
1
5
10
15
20
25
30
35
40
45

FIG.9

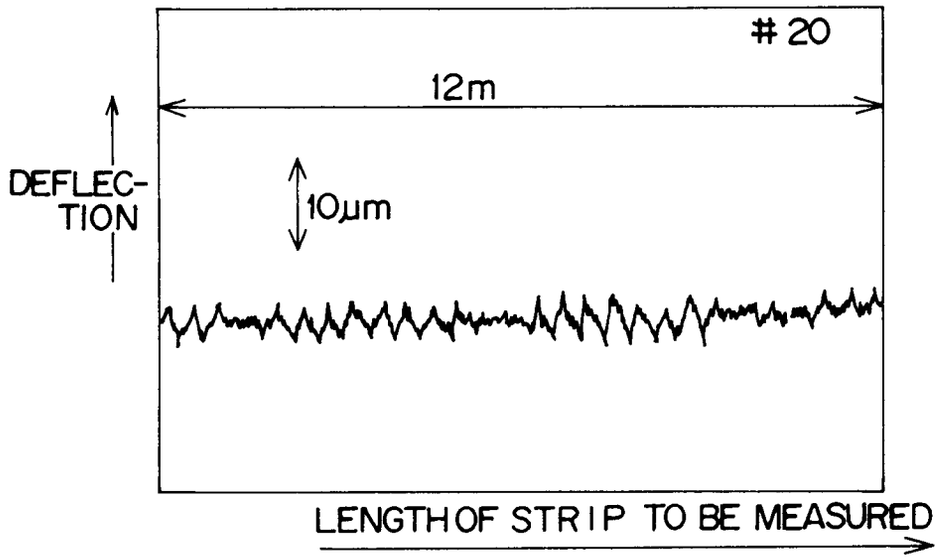

#20
12m
DEFLEC-
TION
10μm
LENGTH OF STRIP TO BE MEASURED

FIG.10

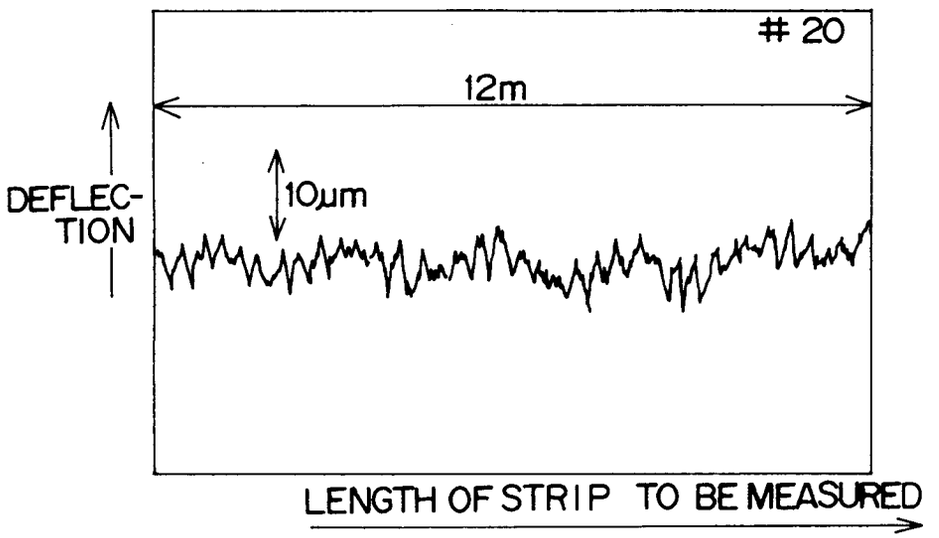

#20
12m
DEFLEC-
TION
10μm
LENGTH OF STRIP TO BE MEASURED

FIG.11

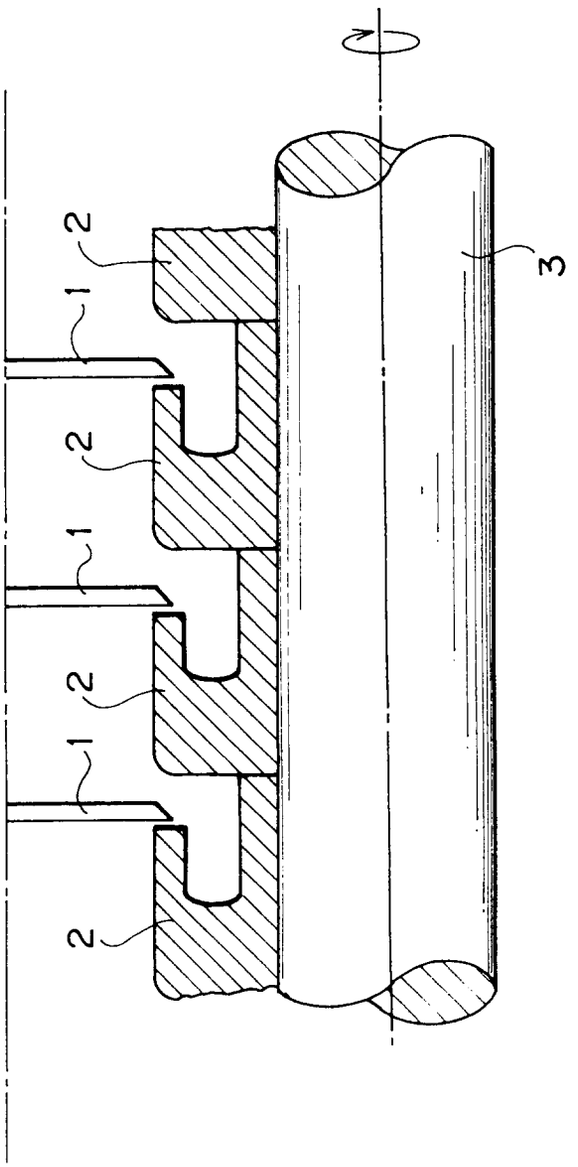


FIG.12

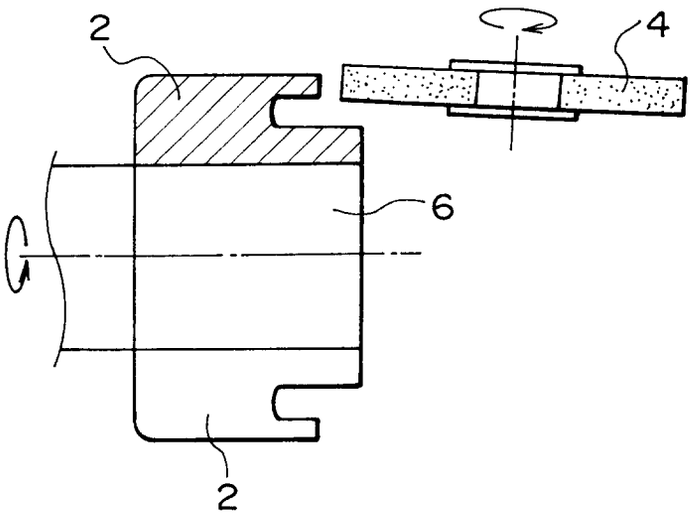


FIG.13

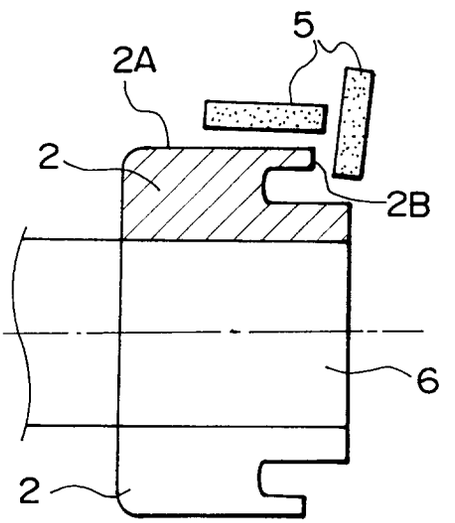
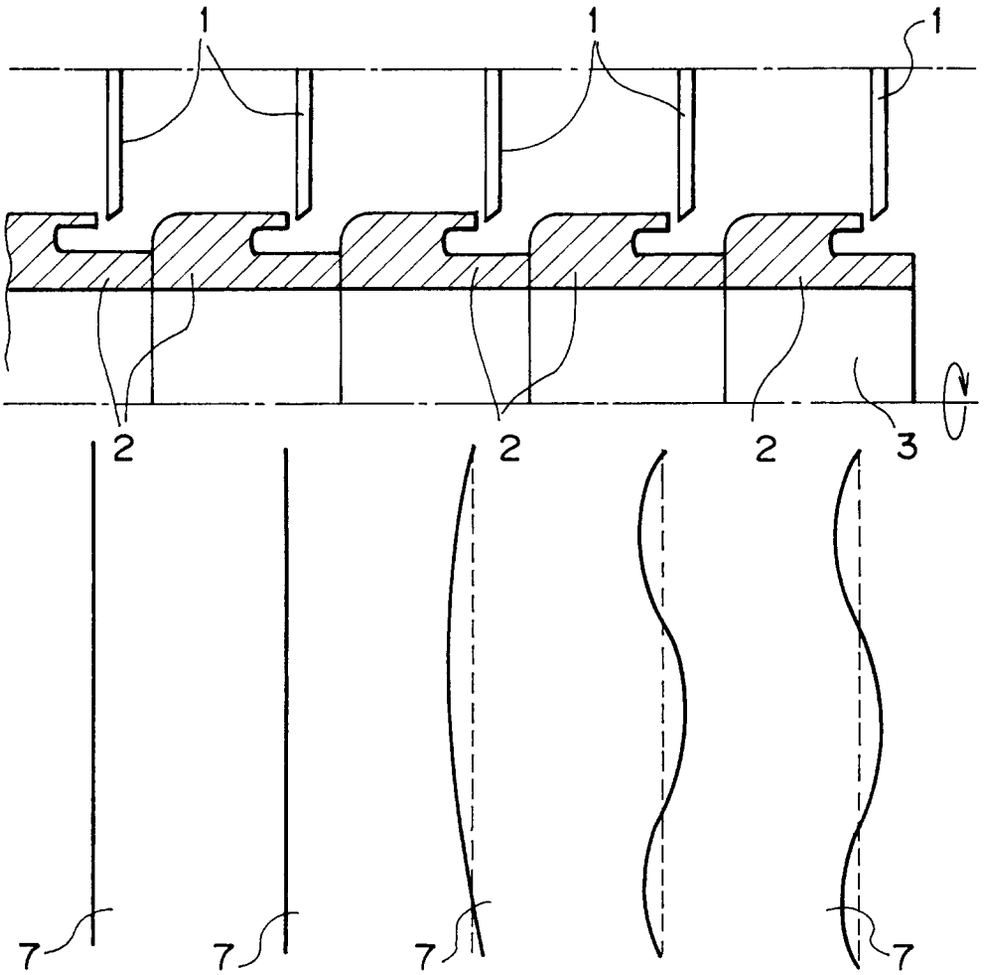


FIG.14



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 12 0345

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)
X	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 23, no. 12 , May 1981 , NEW YORK US pages 5576 - 5577 'Self Sharpening Slitter'	1,2,4,5	B24B3/46 B26D7/12
Y		3	

Y	US-A-1 580 376 (JAROSZ) * page 1, line 98 - line 108; figure 2 *	3	

A	GB-A-2 238 494 (G.D. SOCIETA' PER AZIONI) * abstract; figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
B24B B26D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 April 1994	Garella, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)