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⑤④ **A ROTATING ELEMENT FOR A SCREENING APPARATUS WITH A CONTOUR SURFACE.**

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US-A- 4 202 761

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Description

The present invention relates to an apparatus for screening pulp and more specifically paper pulp. This screening apparatus comprises a vessel, a cylindrical screen within the vessel, provided with grooves : a rotating element moving in the vicinity of the screen at a predetermined speed, the rotating element having a contour surface including a bottom plane and upper plane substantially parallel to the envelope surface of the screen ; an inlet to the vessel for the inscreened pulp, and an outlet from the vessel for the screened pulp both in operative communication with the screen.

In US-A-4529 520, a cylindrical screen plate is described which has an inlet on one side for introducing the unscreened pulp, and an outlet in the opposite side for removing the reject portion. Means are provided for moving the unscreened pulp along one first direction of flow. The screen plate has grooves in the side of the inlet recessed in the screen surface, the first direction of flow being essentially transverse to the grooves. The grooves are formed of an upstream side plane, a downstream side plane and a bottom plane. The bottom plane is essentially parallel to the envelope surface of the screen plate. The grooves have perforations in the bottom plane. The upstream side plane of the grooves, as seen standing from the bottom of the grooves, is substantially perpendicular to the envelope surface and the down-stream side plane of the grooves forms an angle of 60°-5° against the envelope surface. According to a preferred embodiment, the angle between the downstream side plane of the grooves and envelope surface of the screen plate is about 30°. This configuration is called a "contour profile".

In the paper making process, pulp is produced by cooking wood which separates the wood into fibers. Due to the different properties of the wood even from the same tree, some of the fibers do not separate and are dispersed as fiber bundles usually called debris, shives or slivers which form the reject. There are also other impurities, such as bark, which must be removed. The screen must separate the undesirable impurities and debris called the rejects from the accept portion. In order to avoid substantial losses of fibres which could be carried over together with the debris in the reject portion, it is necessary to remove the impurities efficiently and selectively.

It should be stressed that different applications have different requirements. In some application, it is necessary to achieve a high content of long fibers, especially secondary fibers, in the accepts because the long fibers give strength to the final product, for instance paper. In other applications, on the other hand, the contrary is true. For instance, in virgin or pulp mill fibers, it is desirable to concentrate the long fibers in the reject for reject refining.

A great deal of work has been carried out in con-

nection with the screen plates and the rotors and it has been recognized that means to create pulsations on the rotor will increase the efficiency of the apparatus. U.S. Patent 3,363,759 and U.S. patent 4,318,805 describe drum rotors with a bumped surface which provides pulsations. In U.S. Patent 4,318,805, the bumps take the form of pins projecting from the rotor with enlarged heads, the heads providing the pulses while the pins offer little resistance to flow.

US-A-4,447,320 and US-A-4,200,537 describe rotors which carry blades or vanes moving in the vicinity of the screen which produce a large positive pulse. Other patents describe other types of rotors, for instance US-A-3,726,401 uses a rotor with bumps or protruberances which produce about equal positive and negative pulses. According to this patent, any form of bumps may be used provided it produces the desired pulses, the bumps and the depressions between them creating positive screening and negative screen cleaning pressure pulses.

US-A-3,400,820 describes a rotary member made up of a plurality of separate segments joined together and forming a selected undulating pattern which produces about equal positive and negative pulses.

US-A-4,202,761 describes an apparatus for sorting fiber suspensions having a screen with holes and having a rotating element provided on the side of the screen with cleaning blades and clearing strips by which the fiber suspension moves downwardly in helical shaped paths within the annular space between the rotating element and the screen.

A prior art according to the preamble of the claim 1 is described in EP-A-0,182,688 in the screen thereof being provided grooves with an inclined side plane and an opposite side plane being provided perpendicularly to the circumference of the screen. The rotating element on the side of the screen is provided with protrusions having an inclined side surface as well as an opposite side surface being perpendicular to the circumference of the rotating element.

The object of the present invention is to provide a rotating element which produces pulses which are more effective in keeping the screen from plugging, as compared with rotors which have a curved surface.

This object is solved by the rotating element having grooves formed therein by an inclined plane and a side plane between the bottom plane and the upper plane, the side plane being essentially perpendicular to the first plane on one side of the upper plane, and the inclined plane forming an angle between 30°-60° with the bottom plane on the other side of the upper plane.

The present invention provides a rotating element which increases the intensity of the pulses generated near the openings, either orifices or slots within the screen plate, for the purpose of creating the negative pulses which are necessary to backwash the screen,

and to prevent plugging, thus increasing the flow of the fiber suspension through the openings of the screen. Furthermore a rotating element with very high frequency pulses in addition to sufficient amplitude shall be provided.

The rotating element produces sharp and steep negative pulses, thus resulting in high intensity and the power requirements are reduced.

The rotor permits to operate with smaller orifices in the screen thus improving the screening efficiency. In addition an accept portion of consistency as close as possible to the consistency of the pulp introduced at the inlet is obtained.

Blade type segments are provided to be used instead of a rotor in certain applications in which the continuous surface of a rotor is not desirable, for instance when fractionation of the long fibers should be avoided and a larger inlet screening zone is preferable.

Finally a rotor and blade type segments are provided, which may be advantageously used in conjunction with the screen plate described and claimed in US-A-4 529 520.

It has now been found that a specific shape of the rotor surface and the blade type segments as described hereinbelow, is particularly advantageous in producing the higher intensity pulses and in creating sufficient negative pulses so that plugging of the screen is minimized.

The present invention will be illustrated in more detail by reference to the accompanying drawings of which :

Fig. 1. illustrates a conventional pressure screen using rotating hydrofoils for producing pulses ;

Fig. 2. illustrates the pulses which are produced by the rotating hydrofoil screens of Fig. 1 ;

Figs. 3 and 3a illustrate the contour surface of the rotor in accordance with the present invention ;

Figs. 4 and 4a illustrate the nature of pulses which are produced from a rotor or from the blade type segments with a contour surface according to the present invention, as shown in Figs. 3 and 5 ;

Fig. 5 illustrates the embodiment of the blade type segments instead of a rotor, with a contour surface according to the present invention ;

Fig. 6 shows the contour profile of the screen plate according to US-A-4 529 520.

Fig. 7 illustrates the intensity factor which is the ratio of the change of amplitude over a unit of time with a conventional rotating element ;

Fig. 7a illustrates the intensity factor for a rotating element according to the present invention ;

Fig. 8 is a comparison of the pulse profile of conventional rotor and the rotor according to the present invention.

As shown in Fig. 2, the rotating hydrofoils produce both negative and positive pulses. The symbol O pressure designates the value of the pressure near

the screen surface or the screening zone between the rotating foil and the screen cylinder. When the pulp pressure is greater than the reference O point, the pressure has positive value, which is at maximum at the point A and when it is less than the reference point, the pressure has a negative value, the latter being at a maximum at the point B.

The rotating hydrofoils of Fig. 1 known in the art produce pulses illustrated in Fig. 2. As shown in the figure, the leading surface or nose on the hydrofoil develops a positive pulse with the maximum value or amplitude just about at the minimum clearance point between the foil and the screen. The positive pulse contributes to induce the flow in the screening zone through the apertures within the screen because the flow will always be from a higher pressure zone to a lower pressure zone. However, after the minimum foil clearance point a maximum negative pulse is developed due to the change in slope of the foil blade from its minimum clearance position. As shown in Figure 1, the angle of this slope for most foil blades would be a maximum of approximately 30° or even less.

After the maximum negative pulse point the pressure increases again up to the reference O point. The negative pulses induced by the rotating hydrofoil cause a momentary reverse or back-flow through the apertures within the screen thus dislodging any build-up of fibers at the apertures. This self-induced back-washing is greater, the greater is the negative pulse.

The foils or lobe-shaped surfaces or protrusions of rotors and blade type segments known in the art have leading surfaces curved towards the screen cylinder until the minimum rotor clearance point is reached, followed by a trailing surface curving away from the screen. At the minimum rotor clearance point, the change in slope of the curved surface is O. Shortly after this point, the magnitude of the negative pulses starts to increase to a maximum negative value after which the pulses start decreasing again, thus repeating the cycle, as shown in Fig. 2.

The crux of the present invention resides in providing a rotor and blade type segments with grooves, the grooves having a contour surface being formed of a first plane parallel to the envelope surface, an inclined plane, an upper plane and a side plane, the side plane being substantially perpendicular to the first plane and the inclined plane of the grooves forming a 30-60° angle against the first plane, the upper plane being parallel to the first plane. According to a preferred embodiment this angle is about 45°.

By reference to Figs. 3 and 3a, numeral 1 designates a bottom plane and numeral 2 designates an inclined plane. Numeral 3 designates an upper plane and numeral 4 designates a side plane perpendicular to the bottom plane. Numeral 6 designates the envelope surface to the screen.

By reference to Fig. 5, the same numerals 1, 2, 3 and 4 are used to designate the bottom plane, the

inclined plane, the upper plane and the side plane which is perpendicular to the bottom plane.

As shown in Fig. 3a, starting from reference point A, the leading surface has a bottom plane 1 parallel to the envelope surface. It then slopes forming inclined plane 2 until it reaches the upper plane 3. The length of the upper plane 3 should be between 0,635 cm (1/4 inches) and 7,62 cm (3 inches). After the upper plane, the groove comprises a side plane 4 perpendicular to the first plane 1. The bottom plane 1 may vary from a length of 0 up to 7,62 cm (3 inches).

This feature of the side plane 4 being substantially perpendicular to the bottom plane is essential in order to produce pulses which are more effective in keeping the screen from plugging, as compared with rotors which have a curved surface.

Figure 4 illustrates the pulses from a rotating element having the contour profile according to the present invention. A very sharp negative pulse is produced by the 90° angle in the rotor surface or in the blade type segments. This is due to the rapid change in the flow path of the fluid coupled with a Bernoulli effect caused by the increasing velocity of the fluid within the minimum rotor or blade type segment clearance point. This severe or rapid change in pulsation makes the rotor or the blade type segment more effective in back-flushing the screen cylinder 11. The explanation for this effect is that the maximum velocity and acceleration of the fluid which goes through the apertures during back-flushing must be greater than with conventional pulse producing rotating elements because the change in pulses or amplitude with time is much greater with a contour surface (see Fig. 4a).

The term "intensity of the pulses" within the scope of the present invention is intended to mean the change of amplitude of the pulses per unit time. To state the matter in different words, the intensity is not merely the result of the amplitude but also depends on the fast and sharp change. The intensity factor, IF, is the ratio of the change of amplitude over the unit of time : $\frac{\Delta \text{amplitude}}{\Delta \text{time}}$ (Figs. 7 and 7a).

Figure 4 when compared with Figure 2 shows the superiority of the rotating element of the present invention with the contour surface with respect to conventional rotors or conventional blade type elements. Further, the slope and leading surfaces of the contour rotating elements produce positive pulses which help in inducing the flow of the fibrous suspension through the apertures within the screen. The upper surface 3 is needed just ahead of the side plane 4 to cause the rapid change in pulsation.

Figure 5 illustrates the embodiment in which a large screening zone with a substantial open area is desirable to allow inlet stock to enter the full screening zone, thus minimizing the concentration of the long fibers in the reject and minimizing the consistency of the reject, so that more long fibers are in the accept.

In this embodiment, instead of a rotor, blade type segments are used with a contour surface.

The contour surface of the rotating element, a rotor or blade type segments according to the present invention, provides high frequency pulsations. For instance, with a rotating speed of 600, it is possible to achieve a pulsation frequency of 200 Hz and even higher. The high frequency is advantageous because there is less tendency for the fibers to plug the openings and due to the fact that the pulses also exhibit sufficient amplitude, back-flushing occurs. The higher frequency permits the screen to handle stock of higher concentration.

Comparison of Figures 7 and 7a shows the superiority in intensity factor achieved by the rotating element according to the present invention as compared with a conventional rotating element. In Figure 8 the pulse profile of a conventional hydrofoil is shown in broken line and the pulse profile of a rotor with the contour surface according to the present invention is shown in solid line.

Other advantages of the rotor and blade type segments according to the present invention are that it is possible to reduce substantially the size of the apertures of the screen without any appreciable increase in power consumption, nor with any substantial loss in long fibers and with good yield of the accept portion. The consistency of the accept may be kept essentially the same as the consistency of the stock at the inlet.

The rotor as shown in Fig. 3 and the blade type segment shown in Fig. 5 may be used with conventional screen plates and also in conjunction with the screen plate having a contour profile according to US-A-4 529 520 as shown in Fig. 6.

Claims

1. Apparatus for screening pulp comprising :
 - a vessel ; and a cylindrical screen (10) within the vessel, the screen being provided with grooves ;
 - a rotating element (7) moving in the vicinity of the screen (10) at a predetermined speed the rotating element having a contour surface including a bottom plane (1) and an upper plane (3) substantially parallel to the envelope surface of the screen (10) ;
 - an inlet to the vessel for the unscreened pulp, and an outlet from the vessel for the screened pulp both in operative communication with the screen (10),
 - characterized by the rotating element (7) having grooves formed therein by an inclined plane (2) and a side plane (4) between the bottom plane (1) and the upper plane (3), the side plane (4) being essentially perpendicular to the first plane (1) on one side of the upper plane (3), and the inclined plane (2) forming an angle between 30°-60° with the bottom plane (1) on the other side of the upper plane (3).
2. The apparatus according to claim 1, wherein

said rotating element (7) is a rotor.

3. The apparatus according to claim 1, wherein said rotating element (7) consists of blade type segments (9).

4. The apparatus according to claim 1, wherein the angle between said inclined plane (2) and said bottom plane (1) is about 45°.

5. The apparatus according to claim 1, wherein said bottom plane (1) has a length of 0 to 7.62 cms (0 to 3 inches).

6. The screening apparatus according to claim 2, wherein said rotor extends above the screen surface.

Ansprüche

1. Siebvorrichtung für Pulpe bestehend aus ;
einem Behälter ; und einem zylindrischen Sieb (10) innerhalb des Behälters, welches Sieb mit Rillen versehen ist ;

einem rotierenden Element (7), das sich mit einer vorherbestimmten Geschwindigkeit in der Nähe des Siebs (10) bewegt, welches rotierende Element eine konturierte Oberfläche hat, die eine Grundfläche (1) und eine obere Fläche (3) umfaßt, die im wesentlichen parallel zur Mantelfläche des Siebs (10) sind ;

einem Eintritt in den Behälter für ungesiebte Pulpe, und einem Austritt aus dem Behälter für gesiebte Pulpe, die beide betriebsmäßig mit dem Sieb (10) verbunden sind, dadurch gekennzeichnet, daß das rotierende Element (7) Rillen hat, die darin durch eine geneigte Fläche (2) und eine Seitenfläche (4) zwischen der Grundfläche (1) und der oberen Fläche (3) gebildet sind, welche Seitenfläche (4) im wesentlichen senkrecht zur ersten Fläche (1) auf der einen Seite der oberen Fläche (3) ist und die geneigte Fläche (2) einen Winkel zwischen 30° und 60° mit der Grundfläche (1) auf der anderen Seite der oberen Fläche (3) bildet.

2. Vorrichtung gemäß Anspruch 1, worin das genannte rotierende Element (7) ein Läufer ist.

3. Vorrichtung gemäß Anspruch 1, worin das genannte rotierende Element (7) aus blattförmigen Segmenten (9) besteht.

4. Vorrichtung gemäß Anspruch 1, worin der Winkel zwischen der genannten geneigten Fläche (2) und der genannten Grundfläche (1) rund 45° ist.

5. Vorrichtung gemäß Anspruch 1, worin die genannte Grundfläche (1) von 0 bis 7,62 cm (0 bis 3 Zoll) Länge ist.

6. Siebvorrichtung gemäß Anspruch 2, worin der genannte Läufer sich über die Siebfläche erstreckt.

Revendications

1. Appareil pour tamiser de la pulpe comprenant :
– une enceinte et un tamis cylindrique (10) dans

l'enceinte, le tamis étant muni de rainures ;

– un élément rotatif (7) se déplaçant au voisinage du tamis (10) à une vitesse prédéterminée, l'élément rotatif ayant une surface de contour présentant un plan de fond (1) et un plan supérieur (3) sensiblement parallèle à la surface d'enveloppe du tamis (10) ;

– un orifice d'entrée dans l'enceinte pour la pulpe non tamisée et un orifice de sortie de l'enceinte pour la pulpe tamisée, tous deux en communication, en fonctionnement avec le tamis (10) ; caractérisé en ce que : l'élément rotatif (7) comporte des rainures formées par un plan incliné (2) et un plan latéral (4) entre le plan de fond (1) et le plan supérieur (3), le plan latéral (4) étant sensiblement perpendiculaire au premier plan (1) sur un côté du plan supérieur (3) et le plan incliné (2) formant un angle compris entre 30 et 60° avec le plan de fond (1) sur l'autre côté du plan supérieur (3).

2. Appareil selon la revendication 1, selon lequel ledit élément rotatif (7) est un rotor.

3. Appareil selon la revendication 1, selon lequel ledit élément rotatif (7) comporte des segments (9) du type aubes.

4. Appareil selon la revendication 1, selon lequel l'angle entre ledit plan incliné (2) et ledit plan de fond (1) est d'environ 45°.

5. Appareil selon la revendication 1, selon lequel ledit plan de fond (1) possède une longueur de 0 à 7,62 cm (0 à 3 pouces).

6. Appareil en tamisage selon la revendication 2, selon lequel ledit rotor s'étend au-dessus de la surface du tamis.

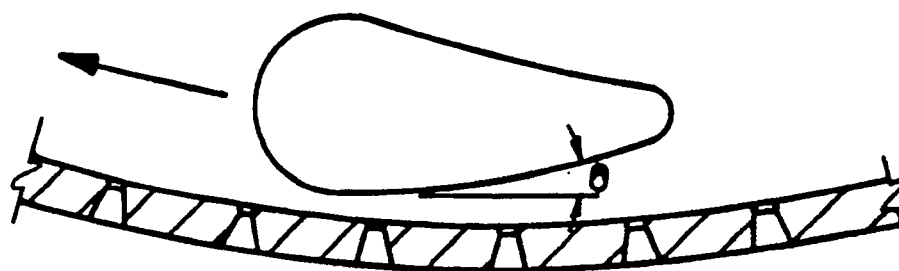


FIG. 1

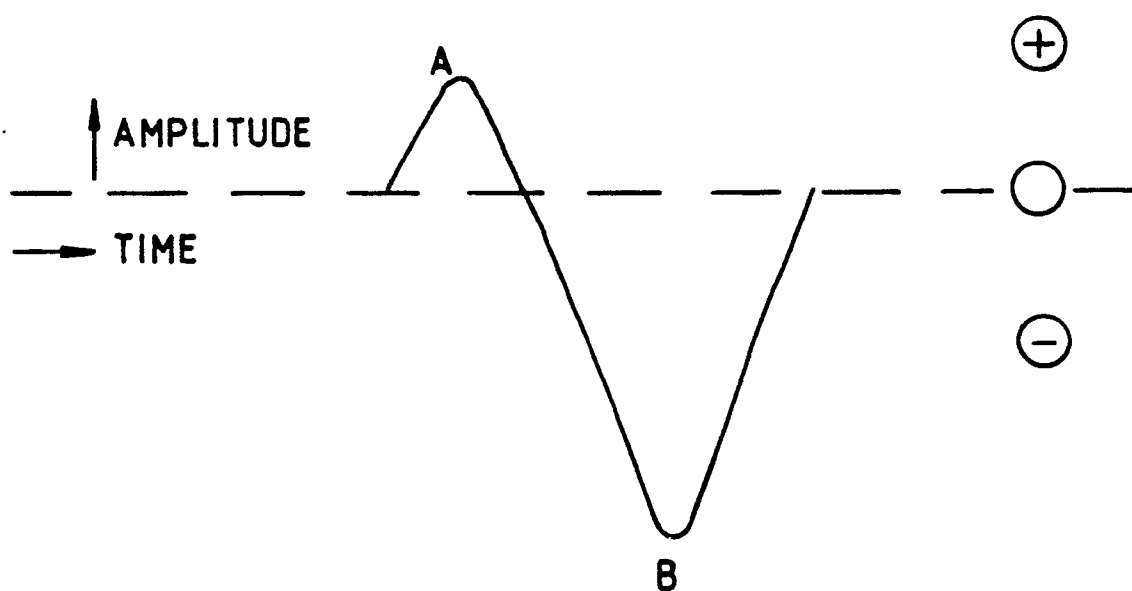


FIG. 2

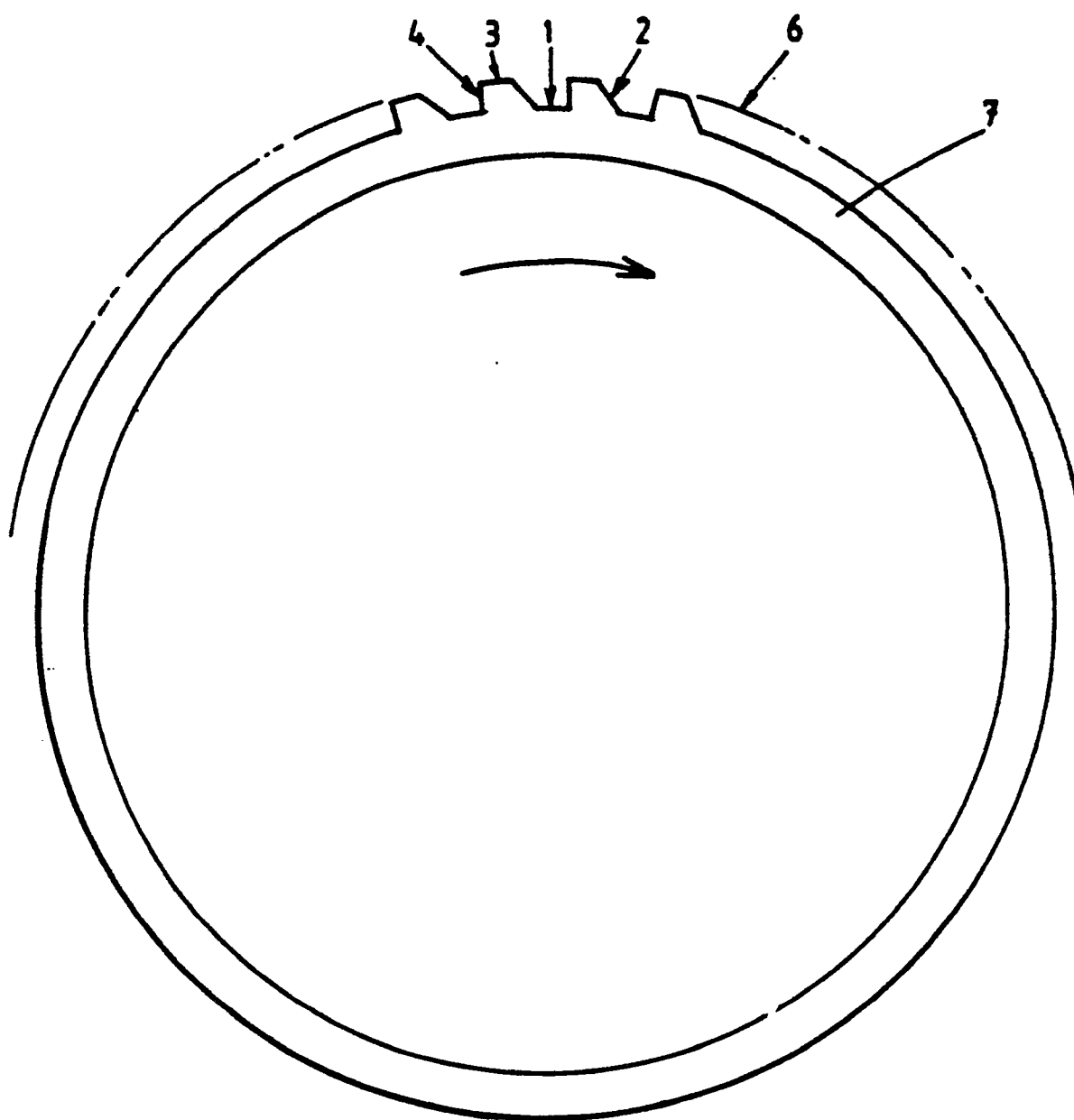


FIG. 3

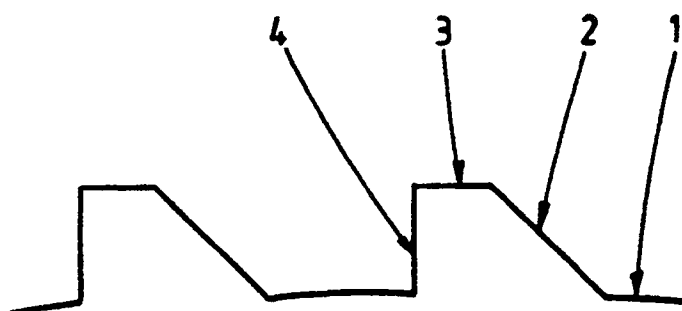


FIG. 3a

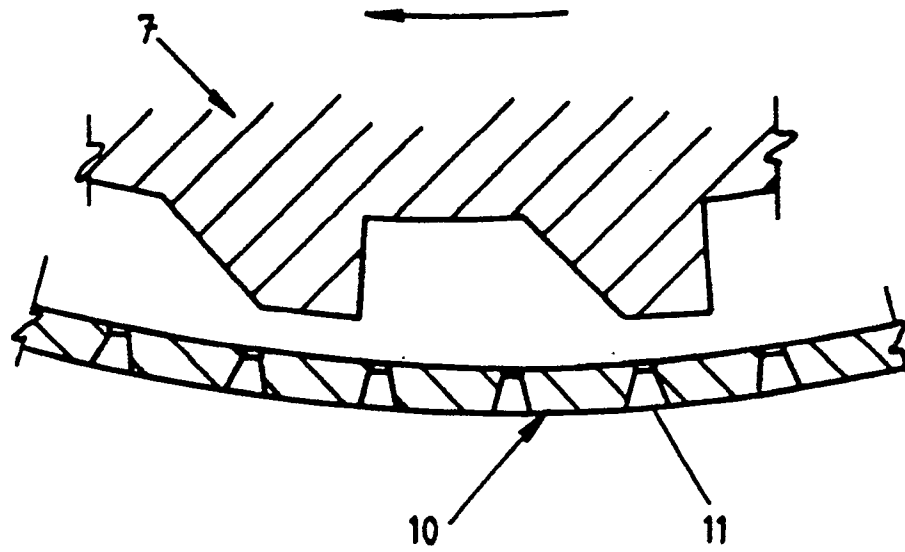


FIG. 4

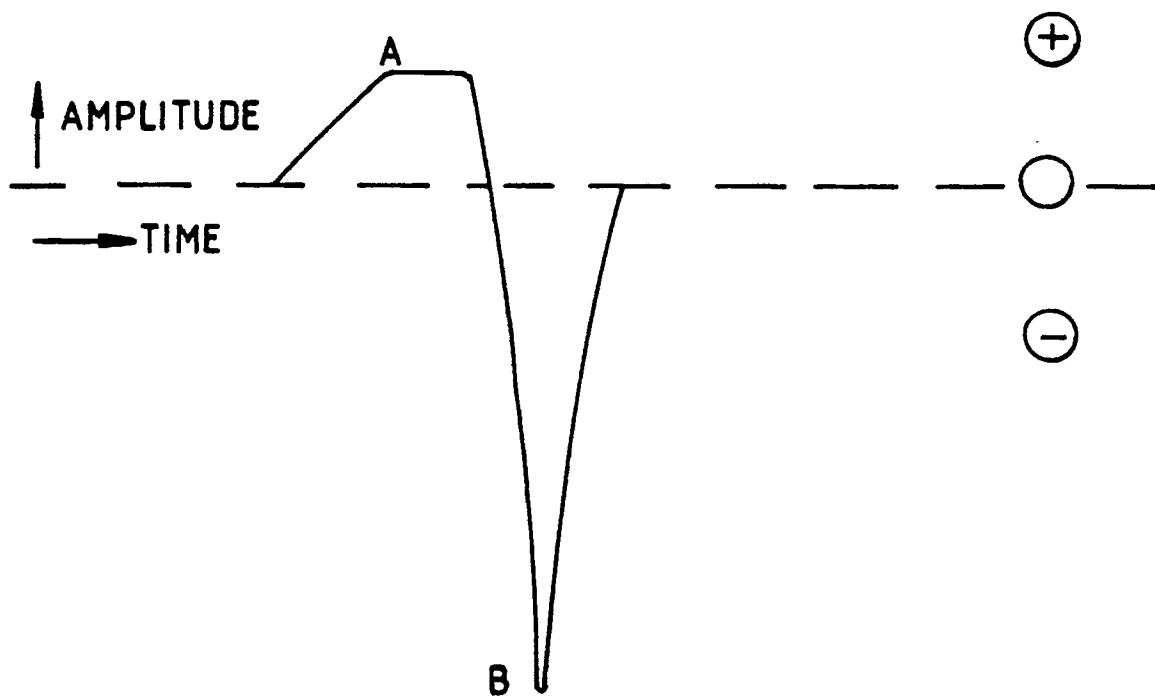


FIG. 4a

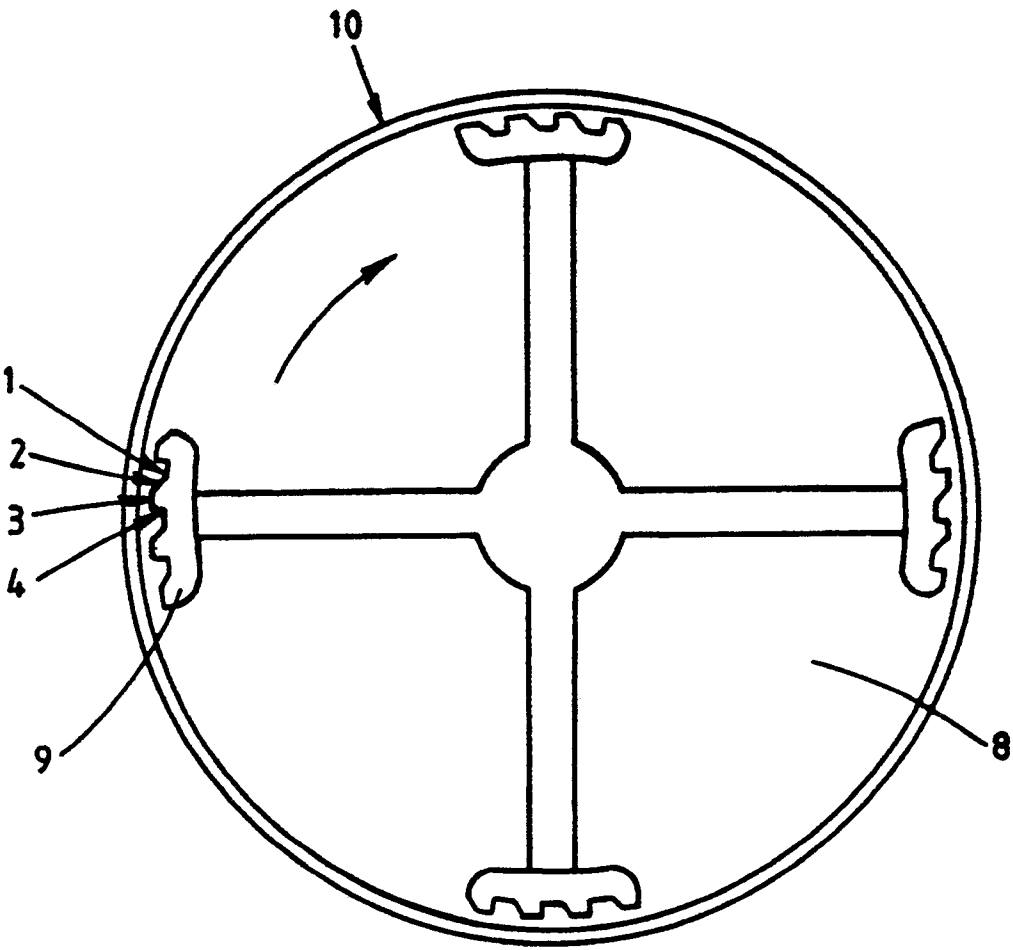


FIG. 5

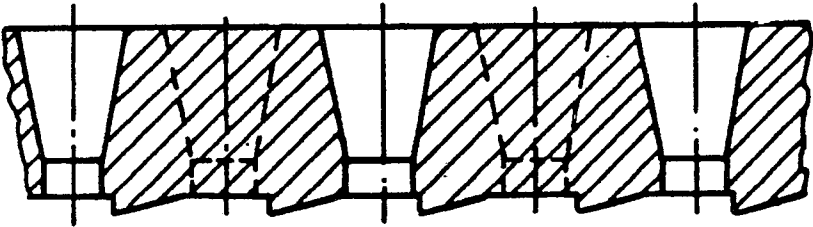


FIG. 6

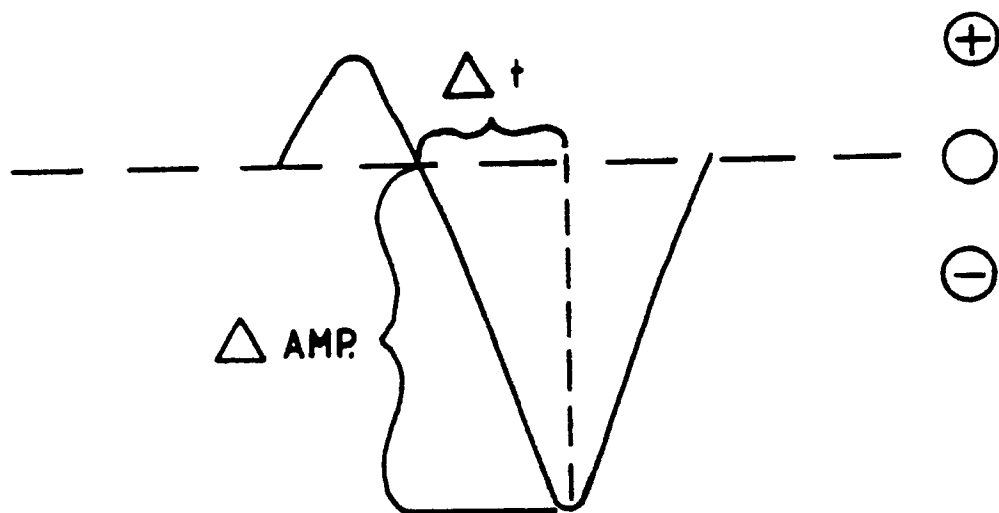


FIG. 7

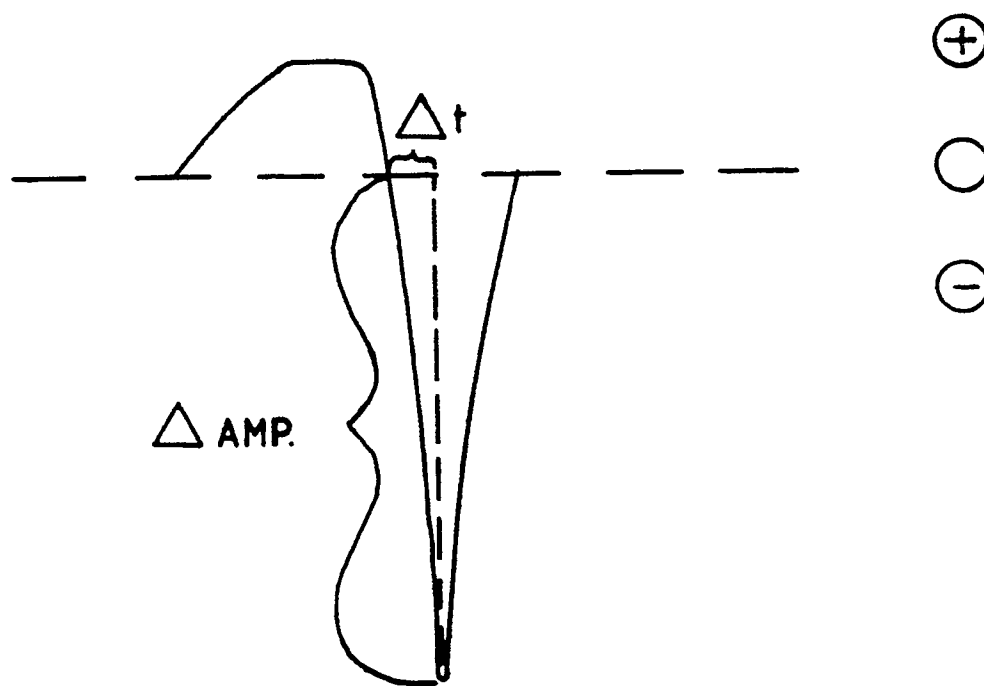


FIG. 7a

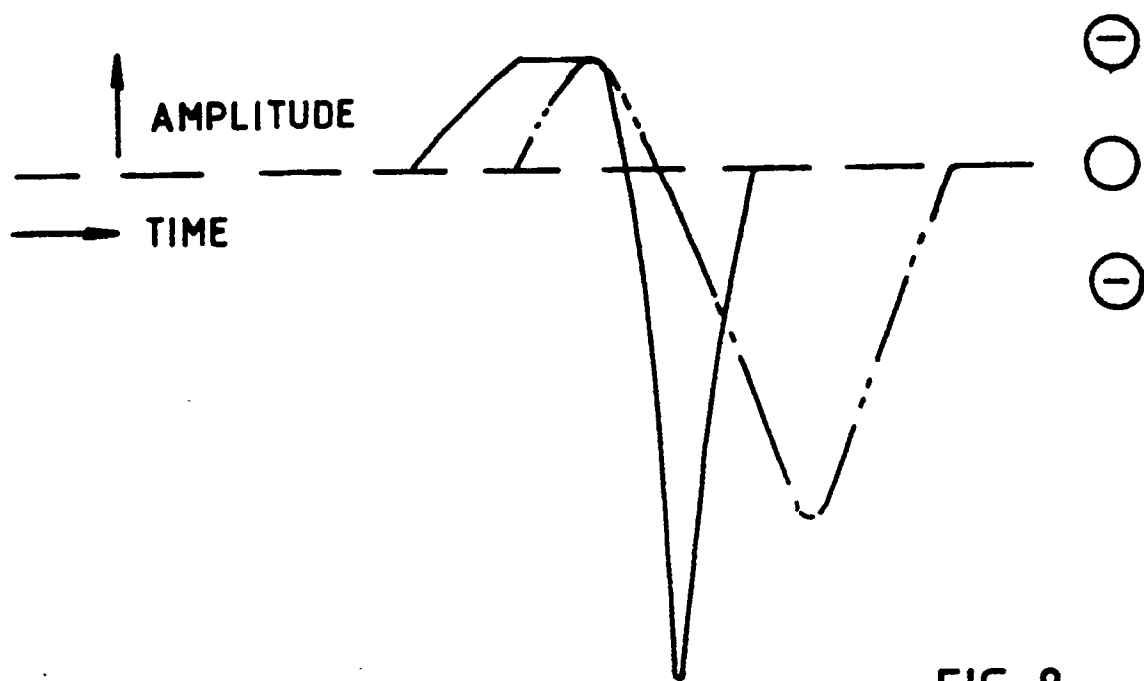


FIG. 8