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CA 2670503 C 2011/10/04

(11)(21) **2 670 503**

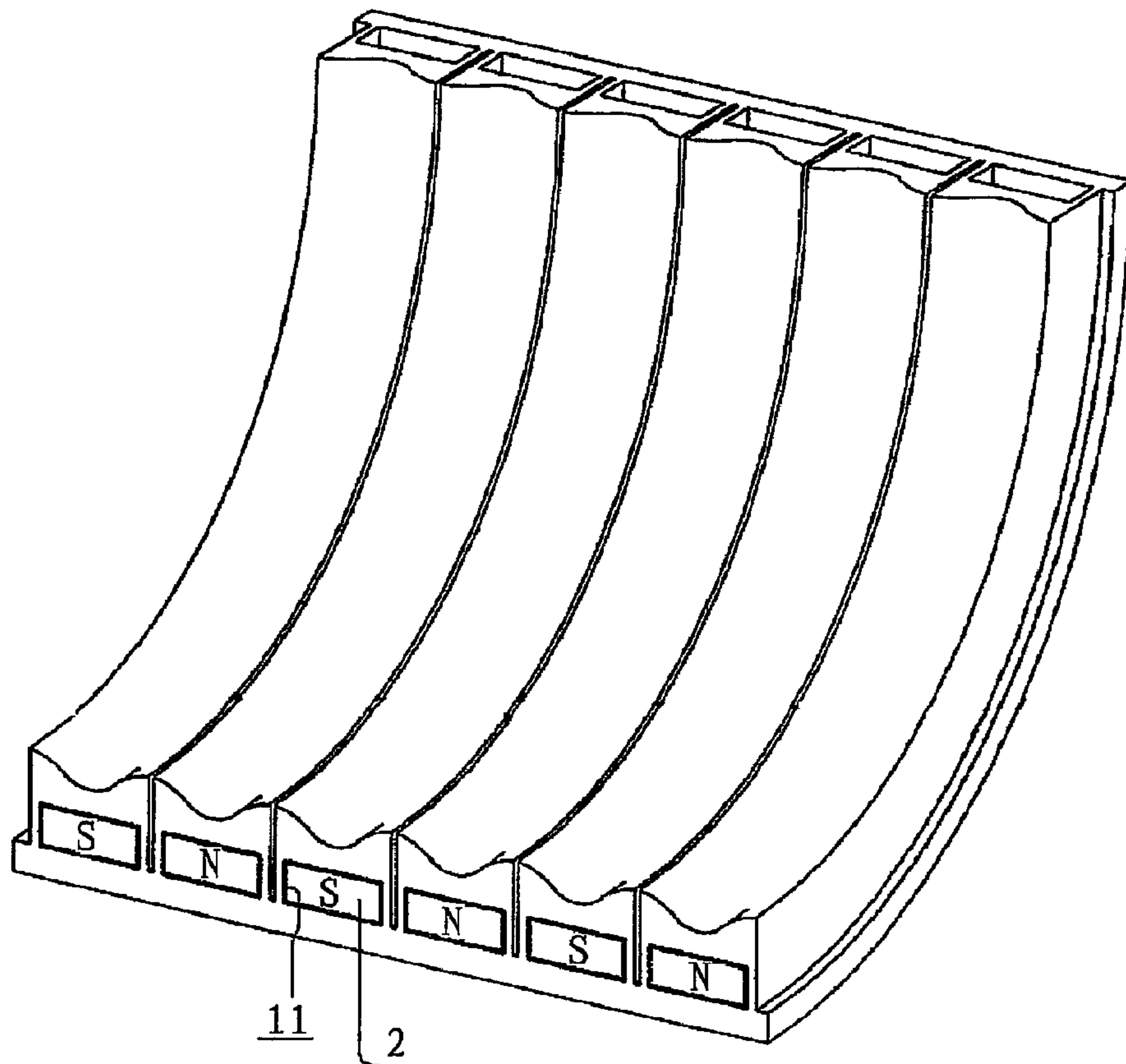
(12) **BREVET CANADIEN**  
**CANADIAN PATENT**

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 2006/11/21  
(87) Date publication PCT/PCT Publication Date: 2008/01/03  
(45) Date de délivrance/Issue Date: 2011/10/04  
(85) Entrée phase nationale/National Entry: 2009/05/25  
(86) N° demande PCT/PCT Application No.: CN 2006/003128  
(87) N° publication PCT/PCT Publication No.: 2008/000112  
(30) Priorité/Priority: 2006/06/22 (CN200620120740.X)

(51) Cl.Int./Int.Cl. *B02C 17/22*(2006.01)  
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(54) Titre : CHEMISE MAGNETISEE A FENTE CIRCULAIRE  
(54) Title: A RING-SLOT TYPE MAGNETIC LINER



(57) Abrégé/Abstract:

The invention relates to a ring-slot type magnetic liner, comprising guard plates (1), permanent magnetic bodies (2), binders (3) and medium protecting layers (4), wherein, more than one dead slots (11) are arranged on the structure of said guard plates (1) at

## (57) Abrégé(suite)/Abstract(continued):

equal distance along the circumferential direction, a permanent magnetic body (2) is installed in each of said dead slots (11), and along the circumferential direction of the guard plate (1), one coil is set as N pole and the other coil is set as S pole; each of the protecting layers (4) is formed on the surface of the guard plate and is of annular shape in the circumferential direction. The invention allows the grinding operation to be carried out in the slots of the ring-slot shaped protecting layer which is formed of cracked grinding balls. The grinding balls contact the materials at an angle range of 120°, and the grinding efficiency is kept constant, so the attritioning efficiency is raised and the yield is increased.

## ABSTRACT OF THE DISCLOSURE

The invention relates to a ring-slot type magnetic liner, comprising guard plates (1), permanent magnetic bodies (2), binders (3) and medium protecting layers (4), wherein, more than one dead slots (11) are arranged on the structure of said guard plates (1) at equal distance along the circumferential direction, a permanent magnetic body (2) is installed in each of said dead slots (11), and along the circumferential direction of the guard plate (1), one coil is set as N pole and the other coil is set as S pole; each of the protecting layers (4) is formed on the surface of the guard plate and is of annular shape in the circumferential direction. The invention allows the grinding operation to be carried out in the slots of the ring-slot shaped protecting layer which is formed of cracked grinding balls. The grinding balls contact the materials at an angle range of 120°, and the grinding efficiency is kept constant, so the attritioning efficiency is raised and the yield is increased.

**TITLE OF THE INVENTION****A Ring-Slot Type Magnetic Liner**

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**BACKGROUND OF THE INVENTION****Field of the Invention**

The present invention relates to ball mill and tube mill liners in the pulverizing engineering field, in particular, to a magnetic liner used for two stage type (fine 10 grinding and rough grinding) ball mills.

**Description of the Related Art**

In the 1980s, SKEGA in Sweden invented a “rubber magnetic liner” applicable to fine grinding and regrinding ball mills with medium diameters  $\leq \Phi$  15 50mm. This “rubber magnetic liner” improved various technical parameters and lifetime of previous ball mill and tube mill lines.

In the 1990s, a “metal-rubber magnetic liner” and a “heavy magnetic liner” were invented in China. The former is applicable to fine grinding ball mills with medium diameters  $\leq \Phi$ 60mm, and the latter is applicable to fine grinding and 20 rough grinding ball mills with medium diameters  $\leq \Phi$ 80mm- $\Phi$ 100mm. Now, these liners have been widely used domestically and abroad thanks to the increase in lifetime, the decrease in ball consumption and power consumption and the improvement in production resulting from the use thereof. However, 25 although the grinding efficiency of large-scale ball mills is slightly improved, the efficiencies of middle and small sized ball mills are still generally very low. The main reason is that the total thickness of a magnetic liner with a protecting layer is usually larger than the thickness of a metal liner, which has great adverse effect on the effective volume of the mills. Therefore the efficiency of middle and small sized ball mills is relatively low and the yield is limited. As a result, 30 magnetic liners are not widely used in middle and small sized ball mills.

A Chinese Patent 03244303.X filed by the applicant of the present application discloses a magnetic liner having a protecting layer of a wave-sloped structure. In this magnetic liner, the grinding medium is in point and line contact with the protecting layer, and the grinding efficiency is low. The present 35 invention is an important innovation based on the above application.

The above discussed conventional magnetic liners still have numerous structural defects and are not convenient in use. It is desirable to provide a new, small-sized and low cost magnetic liner whose functions can be adjusted in use depending on circumstances.

### **SUMMARY OF THE INVENTION**

It is an object of the present invention to overcome the defects of the existing magnetic liners and provide a magnetic liner with a new structure. The technical problems to be solved are: to improve the impact of the attritioning medium grinding balls on the materials, to improve the grinding conditions in the attritioning apparatus, and to increase the attritioning efficiency and the production per machine hour. Thus the yield can be increased and the magnetic liners can be widely used in middle and small sized ball mills.

The above object of the invention and the solving of the technical problems are obtained through the following technical proposal: a slotted cylindrical magnetic liner, comprising one or more protective plates, one or more permanent magnets, binding agent and a protective layer, wherein the one or more protective plates are arranged along the circumference to form a cylindrical body provided on the inner surface of the slotted cylindrical magnetic liner; one or more slots are arranged in the protective plates along the axis of the cylindrical body at equal distance; a permanent magnet is installed in each of said slots; and the protecting layer is of a wave-shaped structure and is formed on the surface of the protective plates along the axis of the cylindrical body..

Preferably the one or more protective plates are configured such that N and S magnetic poles around the cylindrical body are interspersed along the axis of the cylindrical body.

Preferably one or more slot housings with reinforcing sheets are arranged on the one or more protective plates, said slot housings being formed by integral molding or by connecting separate housings together. Preferably the protecting layer is of annular shape and is attached to the surface of the one or more protective plates, grooves along the axis of the cylindrical body being formed under the impact of the magnetic field generated by the permanent magnets.

Preferably the permanent magnets are adhered in the slot housings on the

protective plates by the binding agent, and grinding medium provided in the slotted cylindrical magnetic liner is in direct contact with the protecting layer.

Preferably the spaces between the magnets are set corresponding to the diameter of the grinding medium.

5 Preferably the protective layer is formed of cracked grinding balls, steel segments or other ferromagnetic materials with good magnetoconductivity

Preferably the material of the protective plates is paramagnetic non-magnetic steel or rubber, nylon, polyurethane products, or a composite containing magneto conductive elements.

10 The present invention has remarkable advantages and beneficial effects in comparison with the prior art. By the above technical proposal, the ring-slot type magnetic liner according to the invention can achieve considerable technical progress and utility and has various industrial utility values. The advantages of the invention at least include:

15 1. After the ring-slots are formed in the magnetic liner protective layers, materials can be retained in the slots, thus the grinding area can be increased. A magnetic system can be designed according to the size of attritioning medium so as to insure the forming of protecting layers which can make the attritioning medium grinding balls in surface contact with the protective layers, thus improving the grinding efficiency.

20 2. High-efficiency ring-slot type magnetic liner. The lifting-disengaging angle of the grinding body grinding balls is larger in comparison with wavelike liners, that is, the grinding body disengages after being lifted at an earlier time. With the same rotating rate and filling ratio, work of raising the medium population during grinding is smaller, thus achieving energy conservation.

25 3. High-efficiency ring-slot type magnetic liner. The grinding body seldom impacts on and wears the liner. As a result, the abrasion loss of the grinding body can be lowered as compared to conventional liners.

30 4. High-efficiency ring-slot type magnetic liner. No riser plates exist in the slots, so the grinding body will not generate pulsating moments caused by uneven lifting. So vibration and noise can be lowered.

35 5. High-efficiency ring-slot type magnetic liner. The liner is light-weighted and is relatively thin, so it can be applied to middle and small sized ball mills and the adverse effect of existing magnetic liners on the yield can be eliminated.

6. High-efficiency ring-slot type magnetic liner. The liner is also applicable to large-scale ball mills, with the provision that the magnetic field strength must be increased and the liner structure must be reinforced.

The high-efficiency ring-slot type magnetic liner according to the invention 5 may completely replace the various existing magnetic liners or other liners applied to fine grinding ball mills so as to further improve the grinding efficiency and lifetime.

Consequently, the ring-slot type magnetic liner according to the invention can improve the grinding efficiency and increase the production capacity. The 10 invention has the above advantages and utility value, and has great improvements in both product structures and functions, and has remarkable technical progress, with improved accessibility and practicability. In comparison with the existing magnetic liners, the magnetic liner according to the invention has additional functions, so it is easier to be applied as a new, advanced and 15 practical design and has a broad industrial utility.

Still other advantages will become readily apparent to those skilled in the art from the following detailed description, wherein the preferred embodiments are shown and described in conjunction with the drawings, simply by way of illustration of the best mode contemplated.

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### **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 shows a three-dimensional diagram of the ring-slot type magnetic liner according to the invention.

25 FIG. 2 shows a sectional view of the ring-slot type magnetic liner according to the invention.

FIG. 3 shows a sectional view of the ring-slot type magnetic liner according to the invention in another direction.

Parts listed:

30 1: guard plate  
 2: permanent magnetic body  
 3: binder  
 4: protecting layer  
 5: grinding medium

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## **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Further description is given by the following embodiments in conjunction with the drawings, but it is not intended to limit the scope of the invention.

5 Referring to FIG 1, 2 and 3, a ring-slot type magnetic liner according to one preferred embodiment is shown, which comprises: protective plates 1, permanent magnets 2, binding agent 3 and protective layers 4.

10 A number of protective plates 1 are arranged along the circumference and form a cylindrical body. More than one protecting layers 4 of wave-shaped peak-valley structure are formed on the surface of the protective plates 1 along the axis of the cylindrical body. One or more slots 11 are arranged on the protective plates 1 along the axis of the cylindrical body at equal distance. A permanent magnet 2 is installed in each of said slots 11. The permanent magnet 2 is adhered in the protective plate by said binding agent 3. When in 15 operation, the grinding medium 5 provided in the slotted cylindrical magnetic liner is in direct contact with the protective layer 4. The protective layer 4 is formed of small or cracked medium attached to the liner surface, whereas said small or cracked medium is produced by the long-term friction and impact of grinding medium grinding balls or cast segments with the materials. Because 20 the protecting layers 4 are of ring-slot type, material layers 41 can be retained in the slots of protective layers 4 and the grinding operation can be carried out in the slots.

25 The one or more protective plates 1 are configured such that N and S magnetic poles around the cylindrical body are interspersed along the axis of the cylindrical body. (as shown in FIG. 1). The protective layer 4 is formed of cracked grinding balls, steel segments or other ferromagnetic materials with good magnetoconductivity. Because of the different arrangement regularities of the permanent magnets 2, the magnetic fields formed have different strength at different positions. Therefore the more protecting layers 4 gather in the positions 30 of strong magnetic field and form a bulge, and the less protective layers 4 gather in the positions of weak magnetic field and form a groove. Moreover, because one circular N pole of the permanent magnet and one curcular S pole of the permanent magnet 2 are set alternately in the axial direction of cylindrical body, the surface of the magnetic liner forms a ring-slot shape, i.e., 35 circular-groove liner. The grinding medium 5 is in line and surface contact with the protecting layer 4, so the grinding efficiency is increased. Determine the

spaces between the ring-slots. The corresponding spaces between the permanent magnets can be designed based on the diameter of the grinding medium 5.

The material of said protective plates 1 can be paramagnetic non-magnetic 5 steel or rubber, nylon, polyurethane products, or a composite containing magnetoconductive elements. The magnetic liner can be directly attached to the inner surface of the mills by the magnetic force of the permanent magnets 2, without using bolts. The conception of the magnetic liner of the invention formed of the above structure is: N and S magnetic poles around the cylindrical body 10 are interspersed along the axis of the cylindrical body so as to change the magnetic system of the existing magnetic liner. The surface of the magnetic liner forms the protective layers of ring-slot shape, The materials can be retained in the grooves and the grinding medium contacts the materials at an angle range of about 120°, and the impacting and grinding is carried out in line 15 and surface contact. The grinding efficacy of the grinding medium on the materials is kept constant and the grinding efficiency is increased considerably. Thus the objects of high-efficiency and yield increase are achieved.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific 20 details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. A slotted cylindrical magnetic liner, comprising one or more protective plates (1), one or more permanent magnets (2), binding agent (3) and a protective layer (4), characterized in that:

the one or more protective plates (1) are arranged along the circumference to form a cylindrical body provided on the inner surface of the slotted cylindrical magnetic liner;

10 one or more slots (11) are arranged in the protective plates (1) along the axis of the cylindrical body at equal distance;

a permanent magnet (2) is installed in each of said slots (11); and

the protecting layer (4) is of a wave-shaped structure and is formed on the surface of the protective plates (1) along the axis of the cylindrical body.

15 2. The slotted cylindrical magnetic liner according to claim 1, wherein the one or more protective plates are configured such that N and S magnetic poles around the cylindrical body are interspersed along the axis of the cylindrical body.

20 3. The slotted cylindrical magnetic liner according to claim 1 or 2, wherein one or more slot housings with reinforcing sheets are arranged on said one or more protective plates (1), said slot housings being formed by integral molding or by connecting separate housings together.

25 4. The slotted magnetic liner according to claim 1, wherein said protective layer is of annular shape and is attached to the surface of the one or more protective plates (1), grooves along the axis of the cylindrical body being formed under the impact of the magnetic field generated by the permanent magnets.

30 5. The slotted cylindrical magnetic liner according to claim 1, wherein the permanent magnets (2) are adhered in the slot housings on the protective plates (1) by said binding agent (3), and grinding medium (5) provided in the slotted

cylindrical magnetic liner is in direct contact with the protecting layer (4).

6. The slotted cylindrical magnetic liner according to claim 1 or 4, wherein a material layer (41) is formed in the grooves on the protective layer (4).

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7. The slotted cylindrical magnetic liner according to claim 1 or 5, wherein the spaces between said magnets are set corresponding to the diameter of the grinding medium (5).

10 8. The slotted cylindrical magnetic liner according to claim 1 or 4, wherein said protective layer is formed of cracked grinding balls, steel segments or other ferromagnetic materials with good magnetoconductivity.

15 9. The slotted cylindrical magnetic liner according to claim 1 or 2, wherein the material of said protective plates (1) is selected from the group consisting of paramagnetic non-magnetic steel, rubber, nylon, polyurethane products, and a composite containing magneto conductive elements.

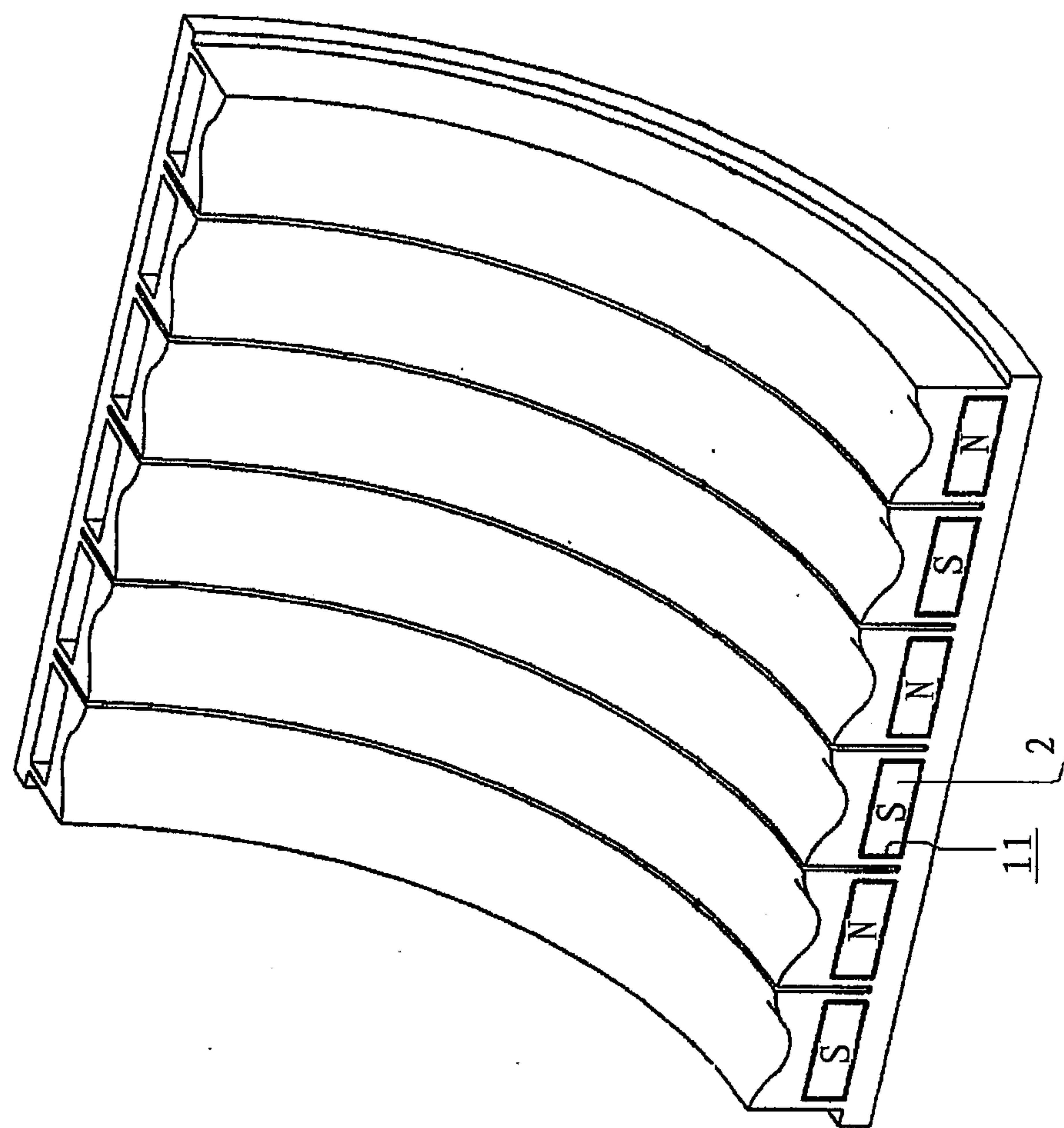


FIG.1

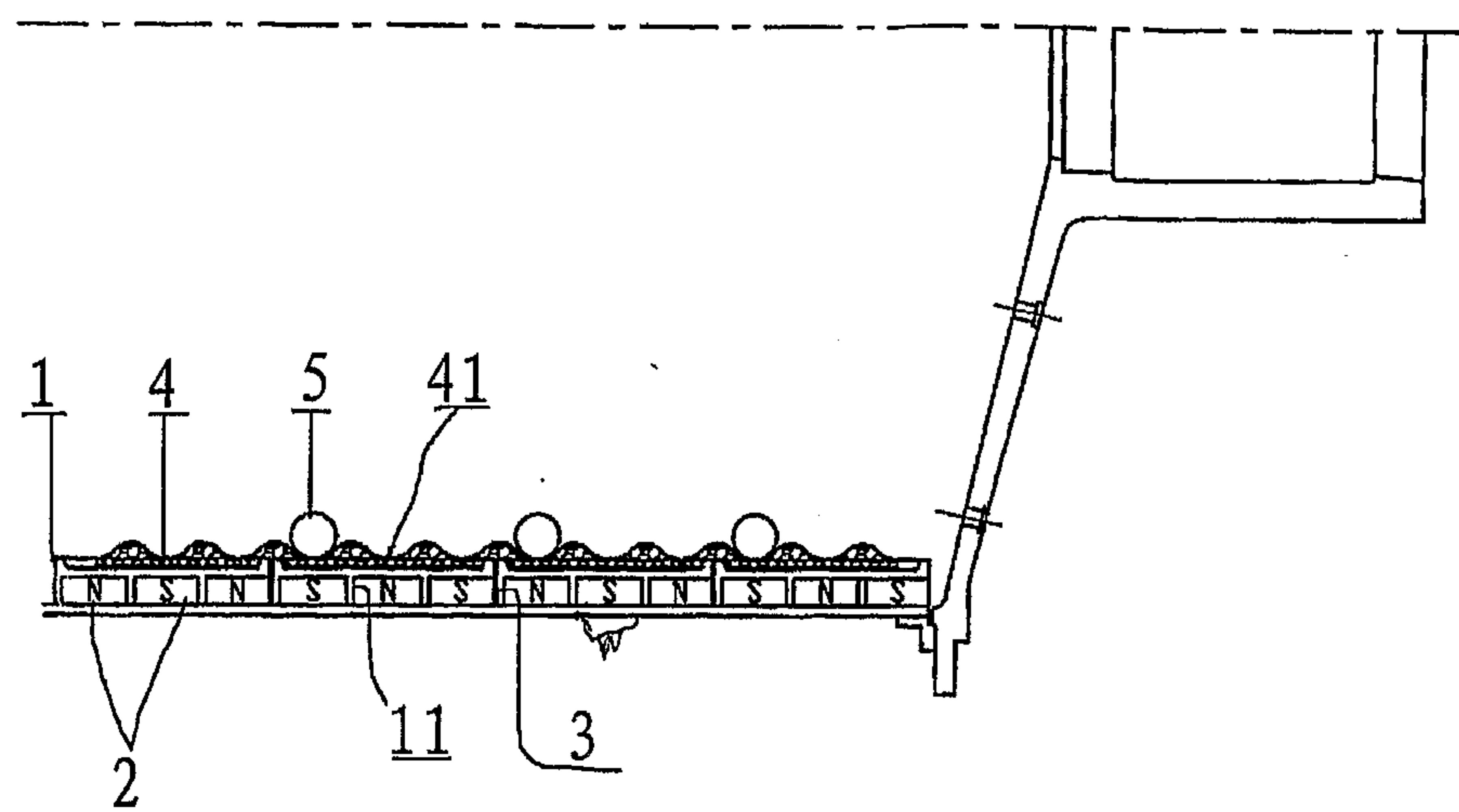


FIG. 2

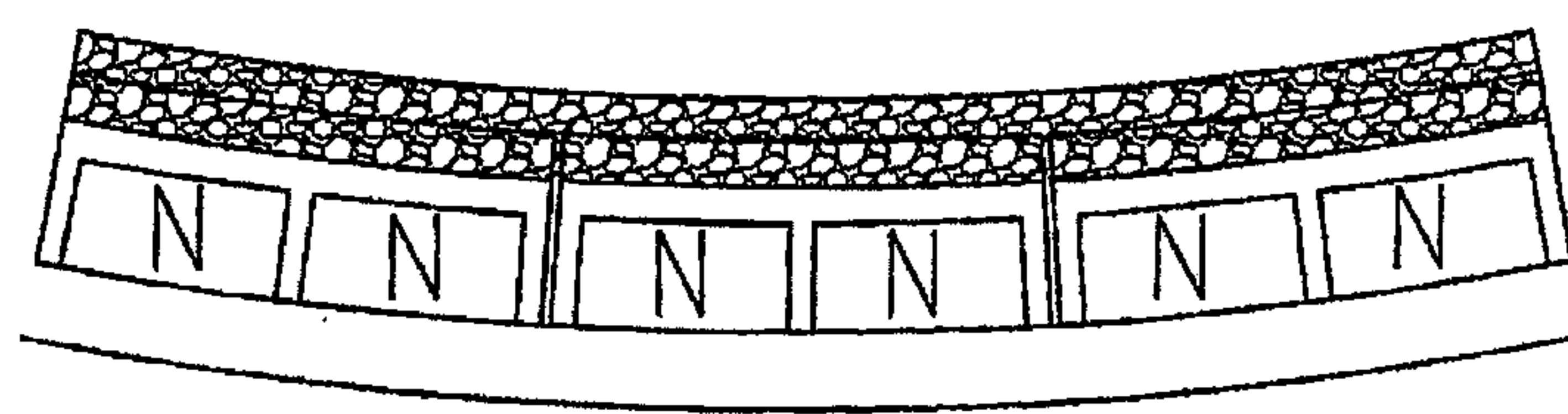


FIG. 3

