

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 567 411 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
06.12.2006 Bulletin 2006/49

(21) Application number: **03777486.6**

(22) Date of filing: **28.11.2003**

(51) Int Cl.:
B63B 21/02 (2006.01)

(86) International application number:
PCT/NL2003/000836

(87) International publication number:
WO 2004/050471 (17.06.2004 Gazette 2004/25)

(54) **APPARATUS FOR MOORING SHIPS**

APPARAT ZUM ANLEGEN VON SCHIFFEN
DISPOSITIF POUR NAVIRES AMARRES

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**

(30) Priority: **29.11.2002 NL 1022025**

(43) Date of publication of application:
31.08.2005 Bulletin 2005/35

(73) Proprietors:
• **Technische Universiteit Delft
2628 BL Delft (NL)**
• **Gemeentewerken Rotterdam
3029 AD Rotterdam (NL)**

(72) Inventors:
• **VERWEIJ, Martin, Daniel
NL-2405 GD Alphen aan den Rijn (NL)**
• **FIKTORIE, Erik, Hendrik, Gerard
NL-2625 VC Delft (NL)**

(74) Representative: **Van Breda, Jacobus
Octrooibureau Los en Stigter B.V.,
Weteringschans 96
1017 XS Amsterdam (NL)**

(56) References cited:
DE-A- 1 911 949 DE-B- 1 129 081
US-A- 4 030 441 US-A- 4 652 845

EP 1 567 411 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The invention relates to an apparatus suitable for mooring ships that have a magnetisable hull, embodied with a series of magnets disposed on or at a quayside.

[0002] Such an apparatus is known from the magazine Delta of 4 July 2002, published by the Delft University of Technology. In this publication it is proposed to use a series of switchable magnets for the mooring of ships. However, the article mentions a few problems that could arise in connection with the possible influence of the applied magnetic field on the cargo of the ship and the equipment on board the ship. When the apparatus is used for mooring a container ship it is, moreover, the question whether the magnetic field does not form an impediment to the removal of the containers from the ship.

[0003] The intended purpose of the invention is to provide an apparatus of the kind referred to in the preamble, wherein the problems just mentioned do not occur and with which further advantages can be attained that will become apparent hereinbelow.

[0004] From DE-OS 1 911 949 which constitutes the closest prior art an apparatus suitable for mooring ships according to the preamble of claim 1 is known.

[0005] In a first aspect, the apparatus according to the invention is characterised in that there are disposed a series of magnets possessing multiple poles, which magnets have magnetic cores that are comb-shaped, with the teeth of the comb forming the magnetic poles, and that the width of the teeth of the comb approximately corresponds to an assumed design thickness of a ship's hull.

[0006] Such multiple poles may be embodied in various ways, for example, as -viewed in cross section- a repeating pattern of circular poles.

[0007] Surprisingly, it has been shown that with the use of magnets embodied in accordance with the invention, it is possible to moor very large ships at the quayside, while the magnetic field to be applied can stay within the limits of the magnets themselves and the ship's hull in the immediate vicinity of the magnets.

[0008] It is desirable for the magnetic poles to alternately form north and south poles.

[0009] In order to realise such an apparatus that serves the intended purpose, the same may suitably be realised such that the magnets are switchable, and provided with excitation windings around the teeth of the comb.

[0010] Advantageous is an embodiment wherein the excitation windings are not alternating current- but direct current-fed. In this way it is possible to avoid eddy-current losses and the accompanying generation of heat in the ship's hull.

[0011] In a further aspect of the invention, the apparatus is characterised in that the magnets on the quayside are moveable in the vertical direction. This makes it possible for the apparatus to be used in harbours that are subject to tidal movement. The up-and-down movement of the moored ships can simply be followed by the mag-

nets.

In a preferred embodiment, the apparatus is characterised in that a control system is provided for alternately switching on and off predetermined groups of magnets, such that during operation in a predetermined period of time each magnet is switched off and on at least once, while the magnets are never switched off all at the same time. If the magnets are disposed in a fixed arrangement, this system makes it possible to apply a very high frequency of switching on and off, allowing for the moored ships' varying height and allowing the system to be used in a harbour subject to tidal movement. If the magnets are moveable in the vertical direction it is further possible to switch the magnets on and off at a relatively low frequency allowing the tidal movement of the ship to be followed, while the movement in the vertical direction of the magnets may be limited.

[0012] Hereinbelow the invention will be further elucidated by way of a non-limiting exemplary embodiment and with reference to the drawing.

[0013] The drawing shows in:

- Fig. 1 a schematic illustration of a ship moored with the aid of an apparatus according to the invention;
- Fig. 2 a single magnetic core of a magnet of the apparatus according to the invention, and
- Fig. 3 a schematic cross section of a magnet of an apparatus according to the invention.

[0014] Similar parts in the figures are identified by identical reference numbers.

[0015] Referring first to Fig. 1, showing a schematic illustration of a ship 1 moored along a quayside 2, at the water side of the quayside 2. A series of magnets 3 are disposed keeping the ship moored. Each of the magnets 3 forms a magnetic circuit with the hull 4 of the ship 1. To this end the ship's hull 4 needs to be of magnetisable material. This requirement is usually met, since most hulls of ships are manufactured in a magnetisable variety of steel.

[0016] Fig. 2 represents a magnetic core 5 of a single magnet 3, showing clearly that in the embodiment illustrated the same is shaped like a comb. The form of the magnetic core 5 is such that the teeth 6 of the comb are provided on a rear plate 7. The teeth 6 form the magnetic poles of the magnet 3 and when the ship 1 is moored, they are oriented towards the ship's hull 4. It is also conceivable to arrange these magnetic poles in any other arbitrarily repeating pattern such as, for example, a repeating pattern of - viewed in cross-section - circular poles.

[0017] The magnetic poles formed by the teeth 6 of the magnetic core 5 are alternately north and south poles. In Fig. 3 therefore, some of the teeth 6 carry the letters N and S to indicate whether a north or a south pole is concerned. As shown in Fig. 3, the windings 8 for exciting the magnet are disposed between the teeth 6 of the magnetic core 5. The person skilled in the art is quite familiar

with such electrical windings and they need no further elucidation.

[0018] The magnets 3 shown in Fig. 1 are preferably arranged on the quayside 2 so as to be moveable in the vertical direction. It is further preferred for the magnets 3 to be coupled to a control system (not shown) for switching predetermined groups of magnets alternately on and off, such that during operation in a predetermined period of time each magnet 3 is switched on and off at least once while, however, the magnets 3 are never switched off all at the same time. This is a simple manner of providing the possibility for the moored ship to follow the tidal movements in the harbour, while the magnets 3 substantially maintain a vertical position on the quayside 2. If a possibility of vertical movement is provided for the magnets 3, the frequency of switching the magnets 3 on and off may be chosen to be relatively low. However, if the magnets 3 disposed on the quayside are fixed without possibility of vertical movement, the frequency of switching the magnets 3 on and off should be relatively high.

[0019] The protective scope merited by the invention is determined exclusively by the appended claims without being limited in any way by the preceding discussion. Said discussion of the invention merely serves to elucidate the appended claims.

Claims

1. An apparatus suitable for mooring ships that have a magnetisable hull, embodied with magnets disposed on or at a quayside, with a pole oriented away from the quayside, **characterised in that** there are disposed a series of magnets (3) possessing multiple poles, that the magnets have magnetic cores (5) that are comb-shaped, with the teeth (6) of the comb forming the magnetic poles, and that the width of the teeth of the comb approximately corresponds to an assumed design thickness of a ship's hull (4).
2. An apparatus according to claim 1, **characterised in that** the magnetic poles alternately form north and south poles.
3. An apparatus according to one of the claims 1-2, **characterised in that** the magnets are switchable, and provided with excitation windings (8) around the teeth of the comb.
4. An apparatus according to claim 3, **characterised in that** the excitation windings are direct current-fed.
5. An apparatus according to one of the claims 1-4, **characterised in that** the magnets on the quayside are moveable in the vertical direction.
6. An apparatus according to one of the preceding claims, **characterised in that** a control system is

provided for alternately switching on and off predetermined groups of magnets, such that during operation in a predetermined period of time each magnet is switched off and on at least once, while the magnets are never switched off all at the same time.

Patentansprüche

1. Eine Vorrichtung, die dazu geeignet ist, Schiffe zu vertäuen, die einen magnetisierbaren Rumpf aufweisen, der mit auf oder an einer Kaiseite angeordneten Magneten verkörpert ist, wobei ein Pol von der Kaiseite weg orientiert ist, **dadurch gekennzeichnet, dass** eine Serie von Magneten (3) angeordnet ist, die mehrere Pole besitzen, dass die Magneten Magnetkerne (5) aufweisen, die kammförmig sind, wobei die Zähne (6) des Kammes die Magnetpole bilden, und dass die Breite der Zähne des Kammes etwa einer angenommenen Entwurfsdicke des Rumpfes (4) eines Schiffes entspricht.
2. Eine Vorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Magnetpole wechselweise Nord- und Südpole bilden.
3. Eine Vorrichtung gemäß einem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, dass** die Magneten umschaltbar sind und mit Anregungswicklungen (8) um die Zähne des Kammes herum versehen sind.
4. Eine Vorrichtung gemäß Anspruch 3, **dadurch gekennzeichnet, dass** die Anregungswicklungen nicht direkt stromgespeist sind.
5. Eine Vorrichtung gemäß einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Magneten auf der Kaiseite in der vertikalen Richtung bewegbar sind.
6. Eine Vorrichtung gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Steuersystem zum wechselweisen Ein- und Ausschalten vorbestimmter Gruppen von Magneten vorgesehen ist, derart, dass während des Betriebs in einem vorbestimmten Zeitraum jeder Magnet zumindest einmal aus- und eingeschaltet wird, wobei die Magneten niemals alle gleichzeitig ausgeschaltet werden.

Revendications

1. Dispositif approprié pour amarrer les bateaux qui ont une coque magnétisable, réalisé avec des aimants disposés sur ou à un bord du quai, avec un pôle orienté côté opposé au bord du quai, **caractérisé en ce que** sont disposés une série d'aimants (3)

possédant des pôles multiples, **en ce que** les aimants ont des noyaux magnétiques (5) qui sont en forme de peigne, avec les dents (6) du peigne formant les pôles magnétiques, et **en ce que** la largeur des dents du peigne correspondent approximativement à une épaisseur théorique supposée de la coque d'un bateau (4). 5

2. Dispositif selon la revendication 1, **caractérisé en ce que** les pôles magnétiques forment alternativement des pôles nord et sud. 10
3. Dispositif selon l'une quelconque des revendications 1-2, **caractérisé en ce que** les aimants sont commutables, et équipés d'enroulement d'excitation (8) autour des dents du peigne. 15
4. Dispositif selon la revendication 3, **caractérisé en ce que** les enroulements d'excitation sont alimentés en courant continu. 20
5. Dispositif selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** les aimants sur le bord du quai sont mobiles dans la direction verticale. 25
6. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'un** système de commande est fourni pour activer et désactiver alternativement des groupes prédéterminés d'aimants, de sorte que pendant le fonctionnement dans un laps de temps prédéterminé, chaque aimant soit désactivé et activé au moins une fois, tandis que les aimants ne sont jamais désactivés tous en même temps. 30

35

40

45

50

55

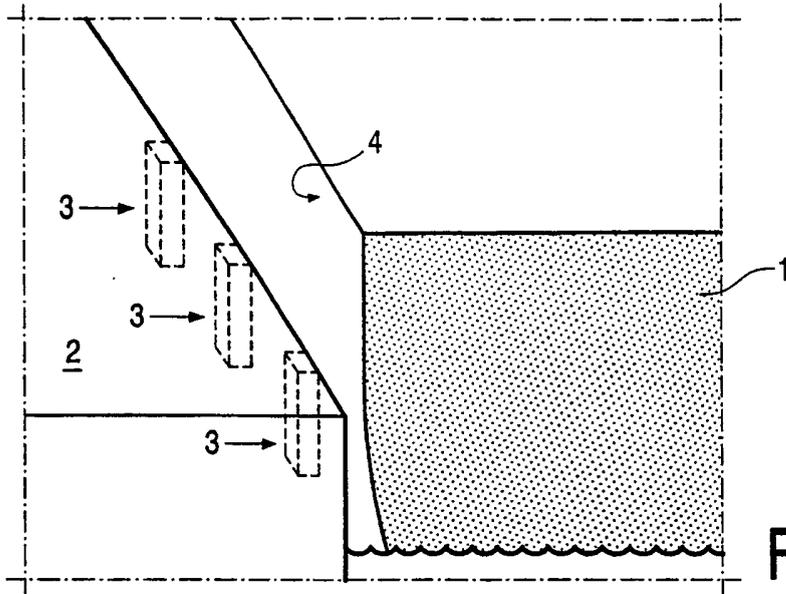


FIG. 1

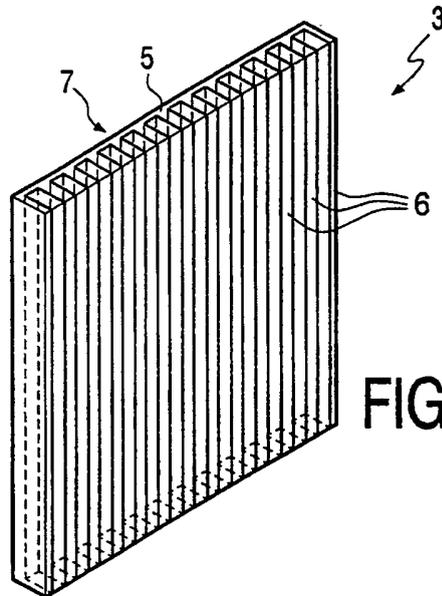


FIG. 2

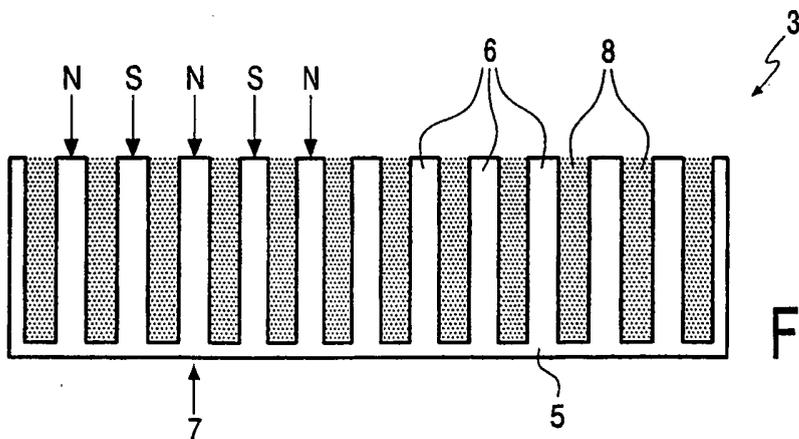


FIG. 3