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⑤④ **Method and apparatus for removing mud from below an underwater construction.**

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⑤④ References cited:
FR-A-2 303 123
GB-A- 830 701
GB-A-2 038 902
US-A-2 192 115
US-A-3 461 674
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Description

The invention relates to a method for removing mud from below an under water construction.

Constructions which have to be placed upon the bottom of a body of water are, notwithstanding whether preparation of the bottom did take place or not, mostly placed on a temporary support, after which a hard supporting layer is applied in the space below the underside of the construction and the rigid bottom, which hard layer dependant from the circumstances can comprise a gravel layer, a sand layer, a mixture of sand and grout, or bags which can be filled under pressure with grout or the like. When one has to start said operations very often a mud layer has been formed in the small intermediate space between bottom and underside of the construction, which layer has to be removed first. It is known to do this with the aid of a suction conduit and suction pump, the mouth of the suction conduit being inserted into the narrow space to suck away in this manner the mass of mud. Said known method is very complicated and insufficiently effective, in particular there where it is difficult to cover sufficiently the narrow space with the suction mouth.

Purpose of the invention is to provide a method and an apparatus as well by means of which mud can be removed relatively quick in a very simple way.

According to the invention this is in the first place achieved in that a gaseous medium is injected into the mud by means of a device which is moved through the mud layer such that said layer is gradually fluidized. By supplying air in sufficient amounts and with sufficient pressure in the correct way over a sufficiently large area the mud layer is broken open and divided into small particles which are taken away by the current generated by the air bubbles. Said air bubbles flow along the underside of the construction towards the place where they can escape upwardly and they take with them mud particles. If this takes place in a waterflow, such as a river, then the mud particles are moved away automatically to be settled somewhere else. If this takes place in stationary water, then the mud particles will be fed upwardly adjacent to the construction, will come to rest there and will settle again in which case, however, they only settle down upon the upper surface of the construction and next to the construction and accordingly no longer in the space which has to be filled with a hard layer.

An example of a construction where the problems of mud deposits can occur is a tunnel section which has been lowered upon a temporary support. For removing mud from below a construction having a length larger than the width a tube provided with openings is inserted in a direction transverse to the longitudinal axis of the construction through the mud layer, said tube having said outlet openings for air over a portion which is substantially equal to the

width of the construction, to which tube air is supplied while the tube is moved in the direction of the longitudinal axis.

Such a tube easily can be inserted below a construction e.g. formed by a tunnel section and subsequently can be dragged through the mud layer in the direction of the longitudinal axis whilst simultaneously air under pressure is supplied. In this way it is possible to free the space from mud during one single passage.

If so desired the tube can extend at an angle with the longitudinal axis of the construction, which has the result that the air bubbles generate a flow towards one side.

Preferably the air jets are directed obliquely forwardly and downwardly seen in the direction of advancement.

The angular position preferably is between 30 to 80° with respect to the vertical. Very good results are obtained with an angular position of 45°. Preferably the angular position is adjustable to enable adaptation to the composition of the mud.

It further can be useful if, seen in the direction of movement, a second tube is provided behind the tube operating on the mud layer with air jets, which second tube is moved synchronously with the first tube and by means of which second tube a screen of air bubbles is generated. This screen takes care that the mud fluidized by the disintegrating air jets, escapes laterally and not rearwardly. As far as it tries to escape rearwardly the flow generated by the air screen will take away the particles. Forwardly an escape is prevented by the mud layer which has not yet been disintegrated by the air jets.

The invention also deals with an apparatus for applying the method according to the invention and said apparatus comprises a tube having a row of outlet openings and having a connecting hose for pressurized air, which tube at the outer ends has circular guiding flanges to which drawing members are connected by means of which the angular position of the outlet openings is adjustable. The circular guiding flanges form slitches which by the drawing members connected to them are prevented from rolling so that the one adjusted annular position of the air outflow openings is guaranteed.

It is possible as well to make the apparatus such that the tube is V-shaped with the point of the V directed into the direction of movement. At the location of the point of the V and at the ends slide shoes have been provided.

If a second tube is applied for generating an air screen, then said tube preferably is connected to the first tube and has upwardly directed outflow openings.

It is observed that it is well known in the art of the maintenance of lakes or rivers to lower a tube onto the bottom of the water, which tube has been provided with air outlet openings and into which air under pressure is supplied and which tube can be moved over the bottom by means such as a vessel. An example of a sediment

remover which directs fluid jets into the sediment layer is disclosed in US—A—2192115. Said prior publication deals with the situation in an open environment in which there are no problems with respect to the accessibility of the mud layer. It might be astonishing that experts knowing how to remove mud layers in rivers and ponds by means of aeration or suction never considered the possibility how to act in a more efficient way and design a more effective apparatus for removing mud layers hidden below an under water construction.

The invention now will be further elucidated with reference to the drawings.

Figure 1 is a schematic view of the principle of the invention.

Figure 2 in the same way as figure 1 shows an alternative of the method according to the invention.

Figure 3 is a top view showing the use of the apparatus according to the invention at a tunnel section.

Figure 4 is a side view of figure 3.

Figure 5 schematically shows the coupling of adjustable drawing members for the apparatus shown in figures 3 and 4.

Figure 6 is a top view of another embodiment of the apparatus according to the invention and

Figure 7 shows a third embodiment.

Figure 1 shows a sand layer 1 which may form the bottom of a river or other water, whilst with 2 the lower side has been indicated of a construction e.g. a tunnel section. In the space 3 between 1 and 2 a mud mass is present.

According to the invention a tube 4 is inserted into said mud mass said tube being provided with a row of outflow openings 5 directed obliquely forwardly and downwardly as seen in the direction of movement 6. The air leaving the outflow openings 5 disintegrates the mud layer and whirls it, whilst the air bubbles 7 which rise take with them the loosened particles. Said air bubbles generate an upwardly directed flow which impinges against the lower side 2 of the construction and then escapes laterally as indicated with the arrows 8 and 9. This escape of course also takes place in the longitudinal direction of the tube and accordingly transverse to the plane of the drawing and transverse to the direction of movement.

Figure 2 shows the same device as figure 1 with however added to tube 4 a second tube 10 placed behind it as seen in the direction of movement and having outflow openings 11 at the top from which also an air flow can escape. Said air flow generates an air bubble screen 12 which also impinges against the lower side of the construction 2 and spreads in all directions. This flow has a portion 13 which is directed forwardly and meets the flow generated by the air bubbles 7 leaving tube 4. Due to this a flow is generated transverse to the plane of the drawing and to a restricted degree in forward direction.

Figure 3 and 4 show a tunnel section 13 placed upon a temporary support 14 and 15. In the space

3 between the sand layer 1 and the lower side 2 of the tunnel section there is mud. The apparatus by means of which said mud now is removed according to the invention comprises a tube 4 which at the ends extending outside the width of the tunnel section 13 has been provided with circular flanges 16 and 17 and which within the width of the lower side of the tunnel section 13 has been provided with outflow openings 5. The tube is closed at one end and at the other end connected to a hose 18 for air under pressure. If said tube is moved in the direction of the longitudinal axis which means in the direction of the arrow 6, then the mud layer 3 gradually will be fluidized and therewith removed.

Figure 5 shows an end view of the tube 4 with flange 16 and openings 5. Two rods 19 and 20 are pivotably connected to the flange at 21 and 22 the rod 20 by means of a pin at 23 being secured in one of the holes 24 of the rod 19. By the choice of one of the holes the direction of flow of the openings 5 is brought into a certain angular position which is not changed when the rod 19 is dragged in horizontal direction so that it can slide over the sand layer with the flanges 16 and 17 respectively.

The tube as shown in figure 6 is V-shaped having at both outer ends slide shoes 25, 26 as well as a central slide shoe 27.

The width of the tunnel section has been indicated in figure 6 with the lines 13.

Figure 7 shows an embodiment in which the tube 28 extends at an angle to the direction of movement 6 having slide shoes 29, 30 at the outer ends.

It is observed that the tube can be moved with the speed of e.g. 0.20 meter per minute or less. A higher speed is possible as well, however, e.g. of the magnitude of 0.35 meter per minute.

The escaping quantity of air can change and can be adjusted between a quantity of 1000 to 4000 liters per minute.

Claims

1. Method for removing mud from below an underwater construction (13), characterized in that a gaseous medium is injected into the mud by means of an apparatus (4) which is moved through the mud layer such that said layer is gradually fluidized.

2. Method according to claim 1 for removing mud from below a construction (13) having a length larger than the width, characterized in that a tube (4) provided with openings (5) is extended through a mud layer in a direction transverse to the longitudinal axis of the construction, said tube being provided with said outflow openings for air over a portion which is almost equal to the width of the construction, air under pressure being supplied to said tube whilst the tube is moved in the direction of the longitudinal axis.

3. Method according to claim 2, characterized in that the tube extends at an angle with the longitudinal axis of the construction.

4. Method according to claim 2 or 3, characterized in that the air jets are directed obliquely forwardly and downwardly as seen in the direction of movement.

5. Method according to claim 4, characterized in that the outflow opening lies between an angle of 30°—80° with respect to the vertical.

6. Method according to one or more of the preceding claims 2 to 5 inclusive, characterized in that seen in the direction of movement a second tube (10) is placed behind the tube (4) which operates upon the mud layer with air jets, which second tube is moved synchronously with the first tube and by means of said second tube a screen of air bubbles is generated.

7. Apparatus for applying the method according to one or more of the preceding claims 1 to 6 inclusive, characterized in that it comprises a tube (4) having a row of outflow openings (5) and a connection hose (18) for pressurized air, which tube at the outer ends has circular guiding flanges (16, 17) to which drawing members (19, 20) are connected by means of which the angular position of the outflow openings is adjustable.

8. Apparatus for applying the method according to one or more of the preceding claims 1 to 6 inclusive, characterized in that it comprises a tube having a row of outflow openings and a connection hose for pressurized air, said tube being V-shaped with the point of the V directed in the direction of movement, and slide shoes (25, 26, 27) provided at the ends and centre of the tube.

9. Apparatus according to claim 7 or 8 for applying the method according to claim 6, characterized in that behind the tube a second tube (10) is placed having upwardly directed outflow openings (11).

Revendications

1. Procédé pour enlever la vase de dessous une construction sous-marine (13), caractérisé en ce que l'on injecte dans la vase un milieu gazeux au moyen d'un dispositif (4) que l'on déplace à travers la couche de vase de telle sorte que cette couche soit progressivement fluidisée.

2. Procédé selon la revendication 1 pour enlever la vase de dessous une construction (13) de longueur plus grande que sa largeur, caractérisé en ce que l'on allonge un tube (4) pourvu d'ouvertures (5) à travers la couche de vase transversalement à l'axe longitudinal de la construction, ce tube étant pourvu de ces ouvertures de sortie d'air sur une portion presque égale à la largeur de la construction, de l'air sous pression étant fourni à ce tube pendant que l'on déplace le tube dans la direction de l'axe longitudinal.

3. Procédé selon la revendication 2, caractérisé en ce que le tube s'allonge en faisant un angle avec l'axe longitudinal de la construction.

4. Procédé selon la revendication 2 ou 3, caractérisé en ce que vus dans la direction du mouvement les jets d'air sont dirigés obliquement vers l'avant et vers le bas.

5. Procédé selon la revendication 4, caractérisé

en ce que l'ouverture de sortie est disposée sous un angle de 30 à 80° par rapport à la verticale.

6. Procédé selon une ou plusieurs des revendications 2 à 5 inclusivement, caractérisé en ce que vu dans la direction du mouvement un deuxième tube (10) est disposé derrière le tube (4) qui agit sur la couche de vase au moyen de jets d'air, ce deuxième tube étant déplacé en synchronisme avec le premier tube, et qu'au moyen de ce deuxième tube on crée un écran de bulles d'air.

7. Dispositif pour mettre en oeuvre le procédé selon une ou plusieurs des revendications 2 à 6 inclusivement, caractérisé en ce qu'il comprend un tube (4) qui présente une rangée d'ouvertures de sortie et un tuyau de connexion (18) pour de l'air comprimé ce tube comportant en ses extrémités extérieures des brides de guidage circulaires (16, 17) auxquelles sont reliés des éléments de traction au moyen desquels on peut ajuster la position angulaire des ouvertures de sortie.

8. Dispositif pour mettre en oeuvre le procédé selon une ou plusieurs des revendications 2 à 6 inclusivement, caractérisé en ce qu'il comprend un tube qui présente une rangée d'ouvertures de sortie et un tuyau de connexion pour de l'air comprimé, ce tube étant en forme de V avec la pointe du V dirigée dans la direction du mouvement, et des patins de glissement (25, 26, 27) prévus aux extrémités et au centre du tube.

9. Dispositif selon la revendication 7 ou 8 pour mettre en oeuvre le procédé selon la revendication 6, caractérisé en ce que derrière le tube on dispose un deuxième tube (10) qui présente des ouvertures de sortie dirigées vers le haut.

Patentansprüche

1. Verfahren zum Entfernen von Schlamm von unterhalb einer Unterwasserkonstruktion (13), dadurch gekennzeichnet, dass man mittels einer Vorrichtung (4), die durch die Schlammsschicht bewegt wird, ein gasförmige Medium in den Schlamm auf solche Weise einspritzt, dass diese Schlammsschicht allmählich verwirbelt wird.

2. Verfahren nach Anspruch 1 zum Entfernen von Schlamm von unterhalb einer Konstruktion (13) von grösserer Länge als Breite, dadurch gekennzeichnet, dass in zur Längsachse der Konstruktion senkrechter Richtung ein mit Öffnungen (5) versehenes Rohr (4) in die Schlammsschicht gelegt wird, wobei dieses Rohr mit diesen Auslassöffnungen für Luft auf einem Teilstück versehen ist, welches beinahe gleich der Breite der Konstruktion ist, wobei diesem Rohr Druckluft zugeleitet wird, während das Rohr in Richtung der Längsachse bewegt wird.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, dass das Rohr sich im Winkel zur Längsachse der Konstruktion erstreckt.

4. Verfahren nach Anspruch 2 oder 3, dadurch gekennzeichnet, dass die Luftstrahlen in Bewegungsrichtung betrachtet schräg nach vorne und nach unten gerichtet sind.

5. Verfahren nach Anspruch 4, dadurch gekenn-

zeichnet, dass die Auslassöffnung in einem Winkel von 30—80° zum Lot angeordnet ist.

6. Verfahren nach einem oder mehreren der vorangehenden Ansprüche 2 bis 5 inklusiv, dadurch gekennzeichnet, dass in Bewegungsrichtung betrachtet ein zweites Rohr (10) hinter dem mit Luftstrahlen auf die Schlammschicht wirkenden rr (4) angeordnet ist, welches zweite Rohr synchron mit dem ersten Rohr bewegt wird, und dass mit Hilfe dieses zweiten Rohres ein Schirm von Luftblasen erzeugt wird.

7. Vorrichtung zur Anwendung des Verfahrens nach einem oder mehreren der vorangehenden Ansprüche 2 bis 6 inklusiv, dadurch gekennzeichnet, dass sie ein mit einer Reihe von Auslassöffnungen (5) und einem Verbindungsschlauch (18) für Druckluft versehenes Rohr (4) umfasst, welches Rohr an den äusseren Enden kreisförmige Leitflansche (16, 17) aufweist, mit

denen Zugelemente (19, 20) verbunden sind, mittels welchen die Winkellage der Auslassöffnungen einstellbar ist.

5 8. Vorrichtung zur Anwendung des Verfahrens nach einem oder mehreren der vorangehenden Ansprüche 2 bis 6 inklusiv, dadurch gekennzeichnet, dass sie ein mit einer Reihe von Auslassöffnungen und einem Verbindungsschlauch für Druckluft versehenes, V-förmig mit einer zur Bewegungsrichtung gerichteten Spitze des V ausgebildetes Rohr und an den Enden und in der Mitte des Rohres vorgesehene Gleitkufen (25, 26, 27) umfasst.

10 15 9. Vorrichtung nach Anspruch 7 oder 8 zur Anwendung des Verfahrens nach Anspruch 6, dadurch gekennzeichnet, dass hinter dem Rohr ein zweites Rohr (10) mit nach oben gerichteten Auslassöffnungen (11) angeordnet ist.

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fig-1

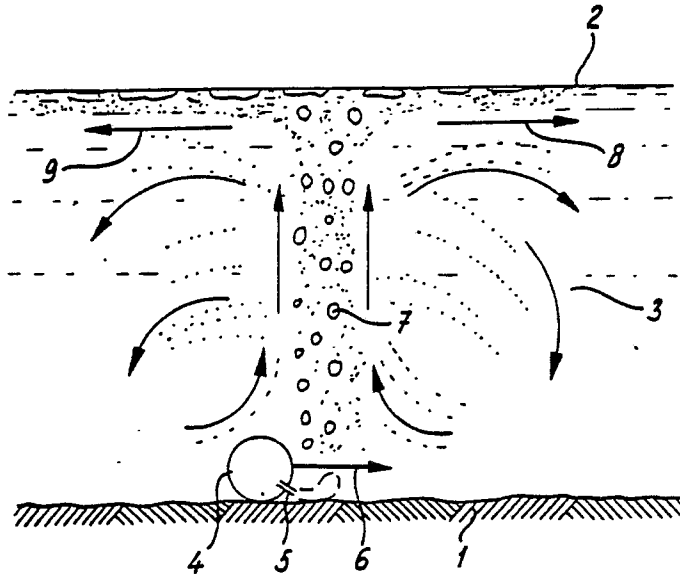
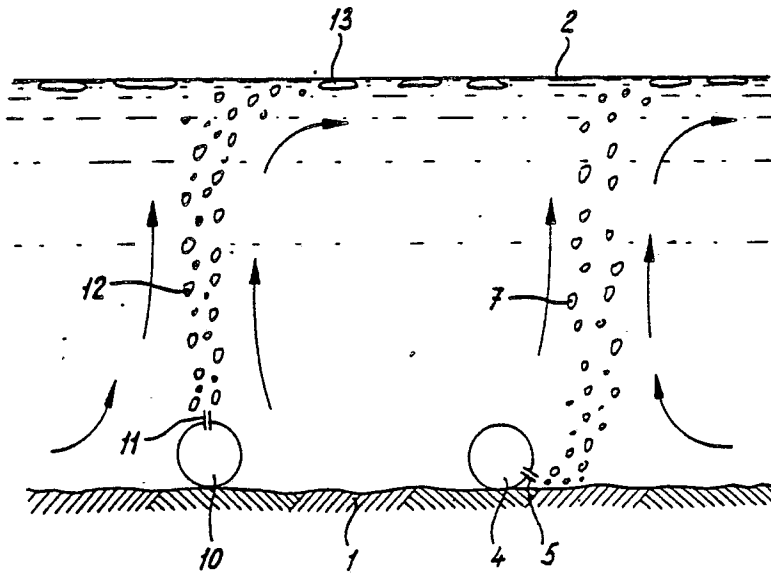


fig-2



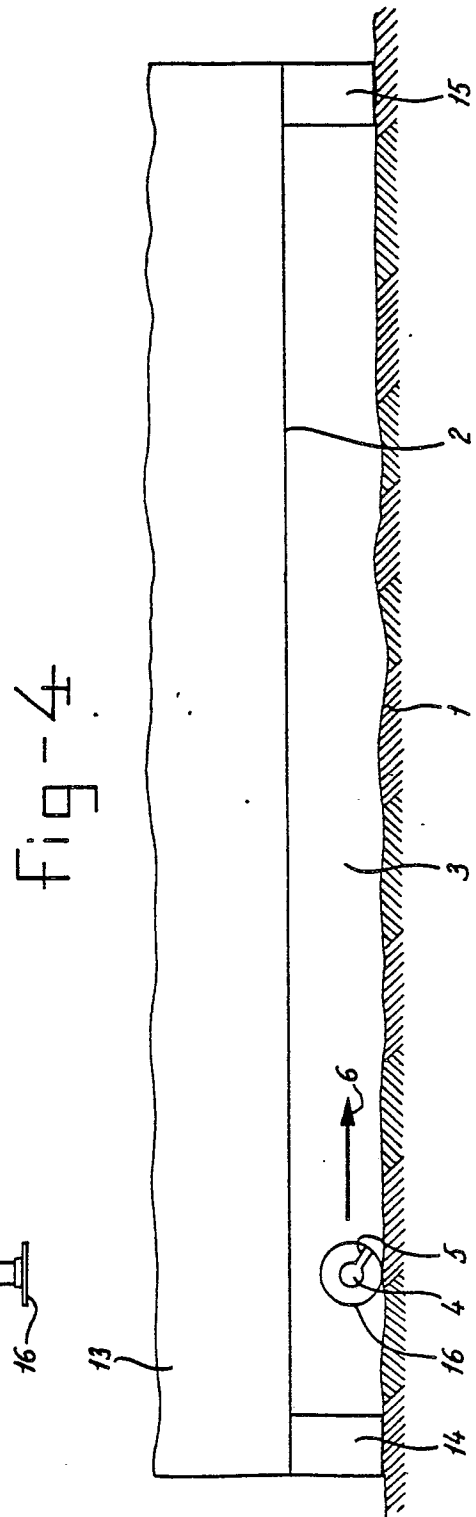
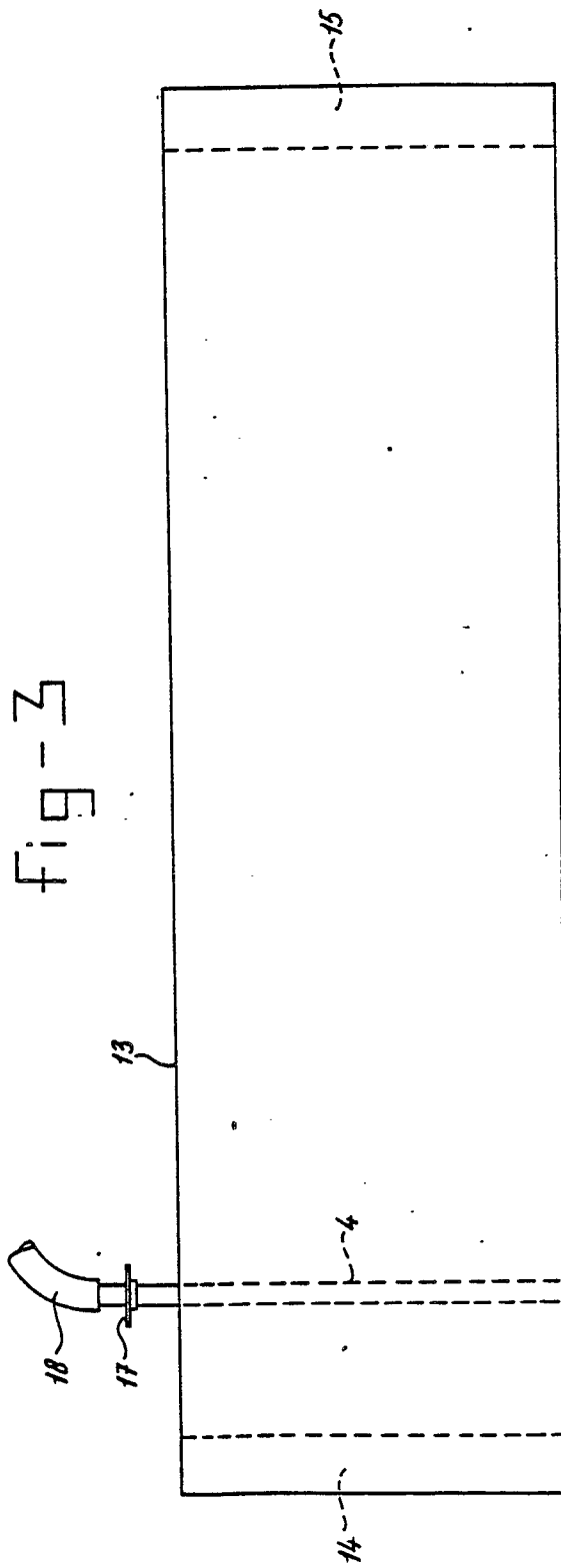


fig-5

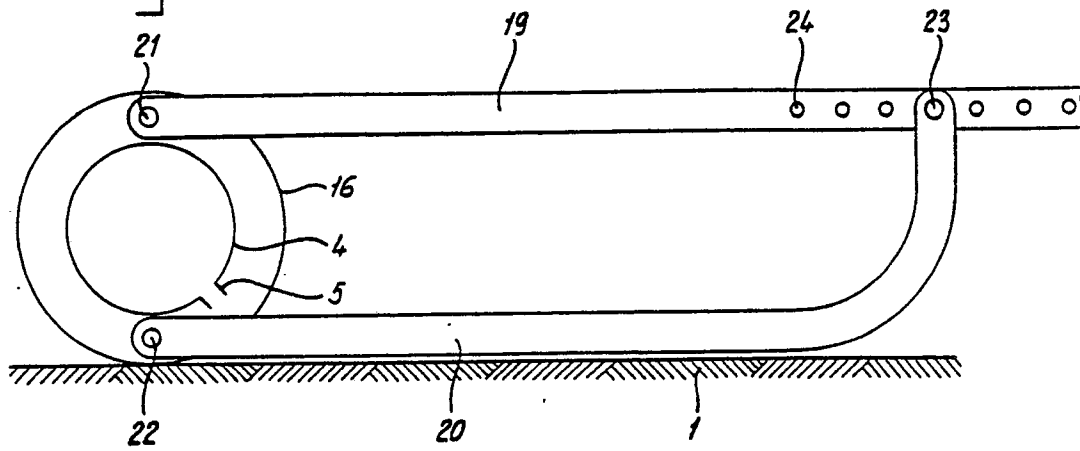


fig-6

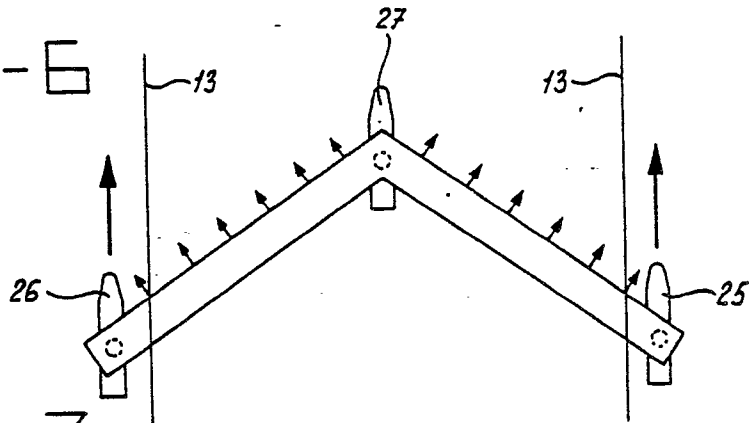


fig-7

