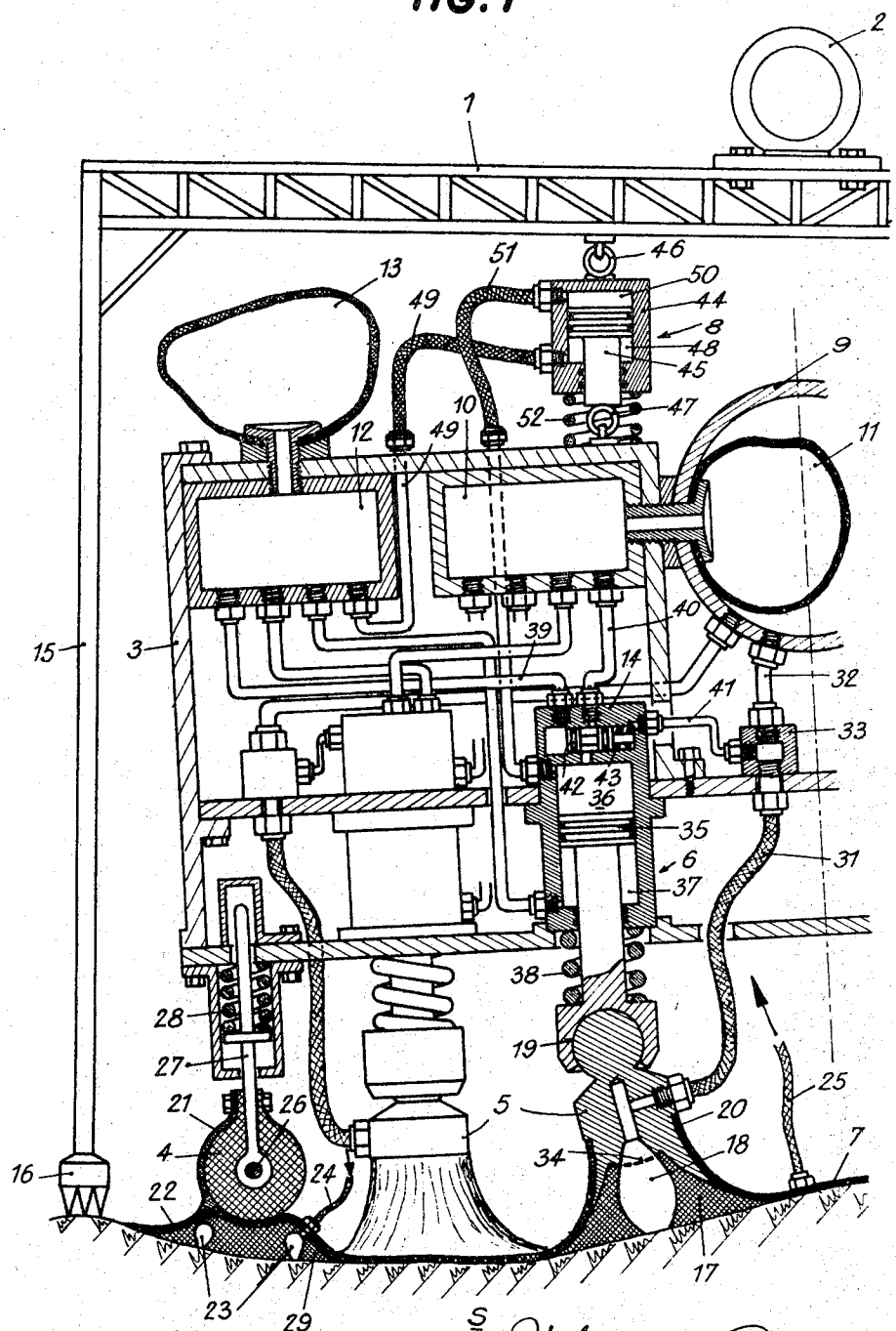
Sept. 22, 1970 W. TIRASPOLSKY ET AL 3,529,919

ANCHORING DEVICES

Filed Sept. 27, 1968 2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

FIG. 2

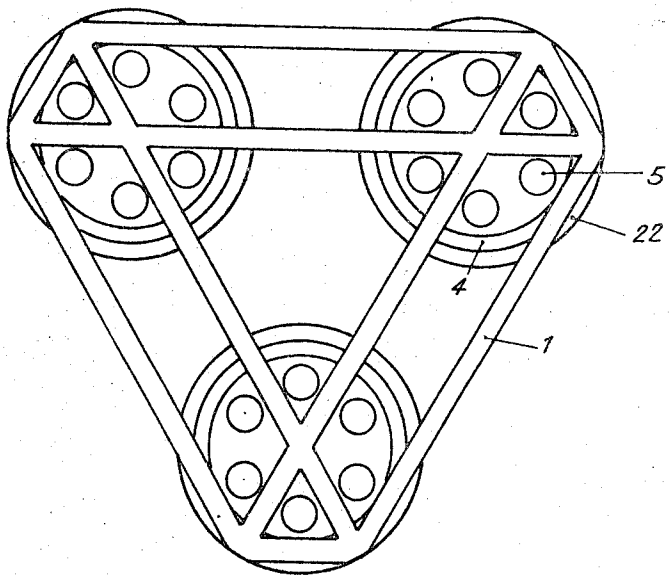
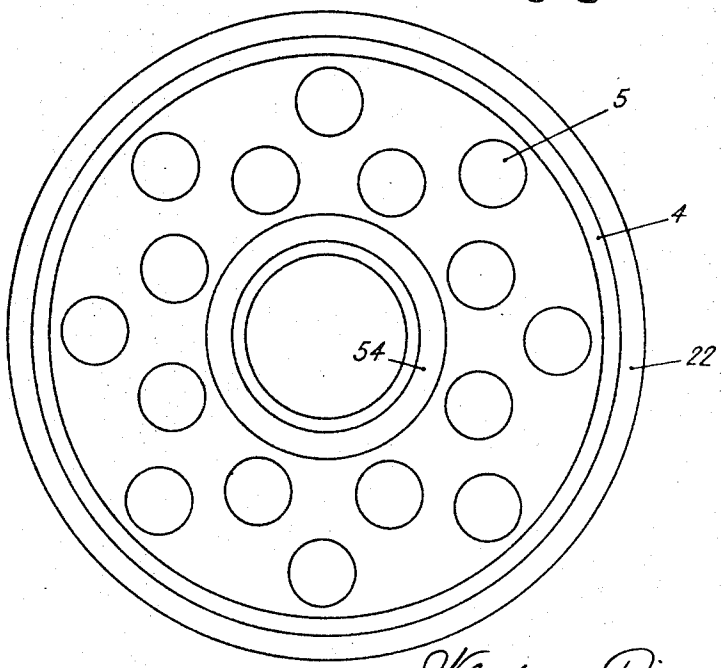


FIG. 3



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United States Patent Office 3,529,919 Patented Sept. 22, 1970

3,529,919

ANCHORING DEVICES

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Filed Sept. 27, 1968, Ser. No. 763,168
Claims priority, application France, Oct. 13, 1967, 124,322
Int. Cl. B63b 21/26
U.S. Cl. 114—206 17 Claims

ABSTRACT OF THE DISCLOSURE

An anchoring apparatus for producing a releasable anchoring to a horizontal or vertical surface, in either a submarine or air environment utilizing a frame upon which a plurality of suction devices are mounted, and the suction devices are related to a cover member disposed over the attachment surface. The cover member includes sealing means, and upon the creation of a vacuum or underpressure in the suction devices by means of vacuum or underpressure supply means, a firm connection to the anchoring surface is achieved. Clamping means are related to the cover member and the frame supporting the suction devices whereby pressure is exposed on the cover member periphery in the direction toward the supporting surface responsive to the force exerted by the suction devices and their supporting members.

At the present time, no positive and reliable means are available for ensuring a removable or temporary and yet non-destructive anchorage on a solid surface or wall having any shape and configuration.

Numerous devices have been proposed for such purposes and are generally termed "suckers" or suction anchors for removably adhering to a solid wall under the action of a local decrease in pressure with respect to the ambient fluid such as air or water. However their use is strictly limited to perfectly smooth and fluid-tight surfaces. Actually such devices lose all their efficiency if the supporting surface has a certain degree of roughness or becomes permeable even to a slight extent.

An object of the invention is to remedy this disadvantage by providing a new or improved anchoring device permitting an anchorage to be achieved either to a smooth surface or to a rugged or irregular surface.

Another object of the invention is to provide an anchoring device permitting a fastening action to be obtained by adhesion even against an irregular surface.

A further object of the invention is to provide a device for temporary or permanent anchorage to the surface of any industrial equipment either under the water or in the free air.

BRIEF SUMMARY OF THE INVENTION

According to the invention, there is provided a new or improved anchoring device comprising at least one suction device, a source of vacuum or decrease in pressure with respect to the ambient pressure to which this device is connected during the operation, an impervious cover member associated with said suction device and defining an area of application upon the anchoring surface surrounding the device, a frame to which said device is connected by elastic suspension members having a constant tension, and fluid-tight clamping means arranged between said frame and cover member so as tightly to apply said means against the periphery of the cover member responsive to the traction exerted between the suction device and the elastic suspension members having a constant tension.

FURTHER DESCRIPTION AND ADVANTAGES OF THE INVENTION

In ane apparently advantageous aspect of the invention, the apparatus includes several suction devices shrouded by the cover member and connected to the frame by elastic suspension members having an independent constant tension.

According to an advantageous feature, the apparatus is supplemented by a framework which is stationary with respect to the anchoring surface and to which the frame is advantageously connected through the medium of elastic suspension members also of the constant tension type.

Owing to the combination of the suction devices with the cover member and to the exertion of a pressure on the periphery of said cover member so as to achieve fluid-tight conditions by a clamping action against the anchoring surface there is obtained an assembly capable of tightly adhering to any surface even if it is uneven, the connection provided between the suction devices and the frame by the constant tension elastic suspension members imparting to said frame with respect to the devices an ability to move producing a compensating effect upon the difference of adhesion power of the devices. Moreover, the method of interconnecting the frame and the framework permits the latter to be held in a stationary position with respect to the anchoring surface in such a manner as to enable it to withstand sufficiently large extracting and shearing stresses as to face most industrial uses.

The apparatus this constituted can be used in any ambient medium possessing a given absolute pressure whether in the air or in a mass of water or any other fluid. However its use is the easier and the more efficient as the fluid is viscous and dense. The preferred field yield of application is the hydrosphere and more particularly submarine grounds situated at a great depth i.e. where no reliable anchoring means are available and the configuration of the bottom of the sea or ocean is often constituted by rocky and bare surfaces, slopes or cliffs.

One particularly advantageous use of this improved device is the provision of a stationary anchoring point. Thus it may be used for behaving as a mooring anchor for ships or other nautical vessels upon rocky sea bottoms irrespective of their slope not only for surface navigation but also and more particularly in connection with subaqueous crafts. The apparatus can also be used for aerial ships or machines such as helicopters or those having a density lower than that of the air so as to permit them to be anchored to a steep cliff, for instance, and permits anchoring points to be obtained for all work conducted on sloping or uneven grounds such as public work sites, quarries and the like. The use of the apparatus is also recommendable in the building industry and for all subaqueous categories of work or handling operations, for instance, by means of boats such as garges or tenders. The apparatus furthermore permits such work to be achieved as will create a reactive stress having a component directed off the surface being worked up, for instance for drilling, grouting or sampling operations regardless of the resistance or outline of said surface. The means to be used may be easily chosen by technicians skilled in the art and form as such no part of the invention.

According to a feature of the invention, each suction device advantageously comprises a rigid central chamber connected by a conduit or line to the source of vacuum or underpressure and a sufficiently flexible peripheral lip to be able to adapt itself to a more or less irregular surface. The adhesion surface of each device is preferably provided with rugged elements checking any skidding action against the surface with which it is in contact, and

it advantageously possesses a sufficient porosity to hold back a viscous liquid that wets the two contacting surfaces preferably to the ambient fluid.

According to another feature of the invention, each suction device is preferably hinged to the frame so as to permit an easier adaptation to the anchoring surface. An elastic or resilient member arranged between the device and the frame normally urges the device away from the frame to a position of maximum protrusion.

In an advantageous aspect of the invention, the elastic suspension members, having a constant tension, that are provided between each suction device and the frame are constituted by balancing pistons movable through cylinders, one face of each piston advantageously communicating with the ambient pressure while its other face communicates with a source of vacuum or underpressure with respect to the ambient pressure. Thus a constant tension is transmitted between the suction device and frame while allowing a relative displacement of this frame with respect to each sucker that adheres to the anchoring surface so as to provide a compensating effect.

In another aspect of the invention, the cover member whose outer wall is impervious is advantageously provided on its surface directed toward the anchoring surface with a network of channels or cells permitting an underpressure or an over-pressure to be created therein through the medium of one or several suitable ducts.

In still another aspect of the invention, the clamping means that ensure fluid tightness of the cover member edge preferably include a peripheral elastic or yielding and fluid tight bead possessing sufficient pliancy for adapting itself to the rugged outline of the anchoring surface. Such a bead is connected to the frame in a preferably elastic fashion so as to achieve the above-stated fluid tightness. Preferably the arrangement is such as to provide an outwardly direct side component capable of tensioning the cover member against the anchoring surface. A portion of the constant tractional stress to which the frame is subjected due to the action of the suction devices is actually transmitted owing to a reactive stress to the aforesaid bead.

The stationary frame advantageously rests upon the anchoring surface by stanchions which may extend either vertically or at an angle to the tractional component transmitted by the frame to the framework and having anti-skidding points, prongs or dogs, the application being ensured owing to the traction transmitted from the frame. Such a framework thus constitutes a skeleton which is held against the anchoring surface and can be fitted with any suitable equipment. Alternatively, the frame may be combined with a propelling device such as a track laying tractor, thereby permitting anchorage thereof at the selected position and then its self-propelled movement to another stationary position.

The source of vacuum or underpressure permitting the service fluid contained in the suction devices to be drained away may be selectively combined with a source of over pressure, thereby permitting release of the devices when this is deemed desirable. When dealing with high ambient pressures, the vacuum or underpressure can be generated by using the arrangement described in French Pat. No. 1,450,584.

In an advantageous arrangement, the desired pressures are supplied to the constant tension members, for example, to pistons, by a closed circuit filled with an operating fluid capable of providing differential pressures.

Still according to a further feature of the invention, an automatic inverting system is provided for performing proper tensioning of those suction devices which have already adhered and the resumption to their initial position of those devices whose adhesion has been deteriorated. Such a system is advantageously supplemented by a declutching and stalling mechanism if devices repeatedly fail to operate properly.

A connecting system with the exterior space is advantageously provided for transmitting information or orders either directly when a mechanical connection subsists with the control station or via remote transmission means for autonomous devices.

If desired, there may be provided a direct guiding system, either remotely controlled or automatic, for imparting proper orientation to the apparatus and including launchable or non-launchable positive or negative ballast weights, also adjusting means for performing proper positioning and recovery of the apparatus. A suitable source of energy is also associated with the apparatus.

According to another advantageous feature, members associated with the suction devices and/or with the cover member permit a fluid to be poured into the contacting gap with the supporting surface, or outside said gap, having such a viscosity or wetting capacity as to improve adhesion and to increase fluid tightness. Alternatively substances such as adhesives or cements producing a final adhesion, the erection of barriers or fences or the creation of grouted joints may be poured into said gap.

A fluid tight sheath or film may be provided for protecting the contact surfaces of the apparatus according to the invention during transportation or approaching operations, said sheath or film being removable when positioning is accomplished.

One or several mechanisms may be provided for liberating a portion of the apparatus such as the framework and frame while leaving the adhesion members in position.

If desired, several adhering units each one of which comprises one or several suction devices, may be housed in one and the same framework, and means may be provided for performing a selective or alternated displacement of some of said units so as to permit the assembly to be suitably advanced without impairing the adhesion. In such a case, the framework itself may have the shape of a carriage such as a track laying vehicle.

In order to facilitate the understanding of the invention and its carrying into practice, it will now be more completely described by way of a non-limitative embodiment with reference to the accompanying drawing exemplifying the same and forming a part of the present disclosure.

BRIEF DESCRIPTION OF THE VIEWS IN THE DRAWING

FIG. 1 is a semi-elevational sectional view taken along an axial plane of an anchoring device operating by adhesion and limited by a circular peripheral bead.

FIGS. 2 and 3 are showings of two ways of clustering elementary suction devices on a framework.

DETAILED DESCRIPTION

In the showing of FIG. 1 are illustrated in sectional view the essential elements of the anchoring apparatus according to the invention, which apparatus comprises a stationary framework **1** intended to be anchored against a surface and which carries in the present case, an attachment ring **2**, a floating or compensating frame **3** provided with a peripheral bead **4**, a set of suction devices **5** connected by a system or linkage **6** having a constant tension but a varying position to the movable or compensating frame **3**, a sealing cover member **7** shrouding the entire area situated inside the peripheral bead **4**, a set of tensioning elements **8** having a constant tension which interconnects the movable frame **3** and the stationary cover **7**, an enclosure **9** in which a differential pressure prevails, said enclosure being connected to the sealing zone and maintaining therein an under-pressure or an over-pressure, a closed capacity containing an operating liquid and including a differential pressure chamber **10–11**, an ambient pressure chamber **12–13**, a regulating system made up in the present case of spool valve **14** adapted to adjust and distribute the tensions between the radiation devices, the frame and the framework in terms of the devices adherence.

The framework **1** is constituted by a skeleton adapted

to provide adequate reception of the equipment as used and rests upon the anchoring surface as shown at S by means of feet **15** terminating in shoes **16** and so distributed as to provide a stable position, for example, at these contacting points which may be chosen at random. These shoes advantageously have a sharp or cutting outline and may be fitted with a remotely controlled or automatic mechanism of the revolvable type operating by percussion or by any other method for ensuring a certain amount of penetration into the anchoring surface S so as to lessen skidding risks, particularly where the device according to the invention behaves as an anchoring point and is subjected to random tractional stresses both in direction and in intensity.

The essential function of the framework **3** is to behave as a relay between the adhering members constituted by the suction devices **5** and their cover member so they possess the required flexibility and mobility to enable them to adapt themselves to the configuration of the ground while limiting and stabilising those tractional stresses which must be borne by each of the adhering members. The function of the framework is furthermore to act as a relay between the sealing peripheral bead **4** to which the frame transmits a fraction of the axial traction taken from the sucker devices for applying said bead against the edge of the cover **7** to which it imparts peripheral fluid tightness and the framework **1** to which said frame **3** transfers the non-used tractional stress for applying said bead while maintaining the immovable position of said framework with respect to the anchoring surface owing to the tensioning systems having a constant or substantially constant force as shown at **6** and **8**. Such systems which are hereafter described more in detail interconnect the sucker devices, the sealing bead and the stationary framework with the movable frame and they are constituted in the present case by balancing pistons also to be described in detail hereafter.

In the constructional embodiment of the invention now being described, the adhering device is constituted by sucker devices **5** having a central armature and a flexible lip **17** which surrounds a fluid circulation cavity or channel **18**, its adhering surface being advantageously provided with a laminar, cellular or other profile permitting the same to better adapt itself to the micro-outline of the anchoring surface, also with cavities, pins or prongs for increasing the coefficient of friction between the contacting surfaces. Said devices **5** are advantageously mounted upon a ball hinge designated by **19** which permits some adjustment of their angular position.

The entire operative area of the devices **5** is shrouded by the fluid tight cover member **7** of which applies itself tightly against the devices body as shows at **20** and is fast with the peripheral bead **4** as shown at **21**, said cover advantageously having an outward extension or lip **22** which is applied owing to its elastic resistance against the surface S beyond the zone of compression as exerted upon the bead. In its peripheral zone the cover member is preferably provided with an irrigation system represented here by channels **23** to which a liquid is fed by conduits **24**, said liquid being adapted to create a better adhesion and a better fluid tightness between the contact surfaces while being fluid enough to stave off any risk of clogging the circulation channels. This liquid is extruded into the interstitial gap provided under the cover member by the pressure exerted upon the latter by the peripheral bead **4**. In the zones situated between the devices **5**, the cover member **7** is constituted on its lower face by a pliable material which adapts itself to the micro-outline and/or has a network of channels centered around circulation ducts such as the conduit **25** adapted to create and maintain a vacuum or underpressure or causing a transitory overpressure under the cover member **7**.

The peripheral sealing bead **4** is constituted by an elastic and pliable material preferably reinforced axially by a supple armature such as the cord **26** and supported at suitable intervals by rigid unions **27** elastically connected, for example via springs **28** to the movable frame **3**. The bead **4** is applied to the periphery of the cover member **7** and exerts a total pushing stress which is equal to the difference between the traction undergone from the devices **5** by the frame **3** and the one which it transmits to the stationary framework **1**, said pushing stress being automatically distributed over the length of the bead depending upon the requirements of the up and down surface so as to ensure a continuous contact between said base bead and the fulcrum area of the cover member. As clearly visible in FIG. 1, there is provided on the lower surface of the cover member in the region corresponding to the bead **4** a lining **29** made of an easily distortable elastic material which is relatively thick so as to provide the required sealing effect.

Each sucker device **5** is connected with the differential pressure chamber **9** through a duct **31**, **32** via a relay **33** which controls the tension-regulating distributors. Each duct **31** is advantageously provided with a filter or purifier as represented by the strainer **34**.

A source of differential pressure, not shown, which may be constituted by a pump or, in the case of deep subaqueous work, by a vacuum or underpressure accumulator which may operate either directly or through the medium of a pressure reducer or a pressure booster or alternatively by any other suitable device maintains inside the chamber or chambers **9** the necessary vacuum or underpressure for performing adhesion of the suckers along the surface S or the overpressure adapted to sweep the area of application before positioning of the devices **5** or alternatively to release the apparatus at the end of the operation. The same source of differential pressure may be used for creating by a jet effect one or several reaction forces for ensuring or facilitating the orientation, the positioning or the disengagement of the apparatus according to the invention.

The fluid conduits **25** connected with the cover members **7** communicate directly with the chamber **9**. Consequently they also propagate a transient underpressure or an overpressure to the cover **7**.

Each sucker is connected with the movable frame **3** by an elastic suspension system having a constant tension which, in the present case, comprises a piston **35** axially movable between a pair of chambers **36** and **37** of a cylinder. This piston is connected by its rod with the hinge **19** that is associated with the sucker **5**. The chamber **37** is held at the ambient pressure while the other chamber **36** may, according to requirements, undergo the effect of the ambient pressure or alternatively an underpressure or an overpressure. A spring **38** arranged between the hinge **19** and the frame **3** urges the device **5** away from the frame.

Control of the pistons is advantageously performed by means of an auxiliary fluid such as a transmitting oil which fills the tight enclosure comprising the ambient pressure chamber **12** which is balanced owing to its combination with the flexible reservoir **13** and the differential pressure chamber **10** which is fed by the flexible container **11** that is immersed in the differential pressure chamber **9**. Regulation is controlled by the pressure prevailing in the device **5** and acting via the relay **33** by means of the spool valves **14** so as to provide an alternative communication between the chamber **36** and the chamber **10** or **12** through the ducts **39** and **40**. As long as the pressure prevailing in the relay **33** connected with the valve **14** through the conduit **41** does not substantially deviate from the ambient pressure, the spool valve **42** is held in its end of stroke position by a spring **43** so as to provide a communication between the chambers **36** and **12**. When the vacuum or underpressure prevailing in the relay **33** reaches a pre-set level, pressure in the chamber **12** pushes back the spool valve **42** for closing the circuit between the chambers **36** and **12** and opening the circuit between the chambers **36** and **10**.

Due to the vacuum or underpressure prevailing in the chamber **10**, the piston then moves towards the frame **3** and exerts upon the device **5** some tractional stress which is proportional to the pressure in chamber **10**. Where the fluid tightness under the device **5** happens to disappear, the corresponding pressure drop in the relay **33** provides a new communication between the chambers **36** and **12** whereby the suction device is re-applied upon the adhering surface S due to the action of the spring **38**. Permissible minimum of vacuum or underpressure in the relay **33** due to the suction exerted from the chamber **9** is adjusted by a nozzle which is incorporated with the conduit **32** in combination with the resistance of the conduit **31**. Where an overpressure prevails inside the chamber **9**, the chamber **36** remains in communication with the chamber **12** and the suction device preserves its initial position, i.e. at a maximum distance from the frame.

In the constructional embodiment shown in the drawings, the movable frame **3** is connected likewise with the stationary framework **1** via cylinders **44** and pistons **45** arranged between two hinged shackles **46**, **47**. The chamber **48** defined by the cylinder is then put into communication with the ambient pressure chamber **12** via a conduit **49** while the differential pressure chamber **50** is advantageously connected with the chamber **36** of a corresponding suspension member provided between a device **5** and the movable frame via a conduit **51**, thereby providing a constant ratio so far as the distribution of tensions between the suction devices, the frame and the sealing bead are concerned.

Position of the connections between the framework **1** and the frame **3** is chosen in accordance with the distribution of strains undergone by the framework **1** during the operation of the anchoring apparatus.

The energy for operating the several mechanisms of the apparatus and more particularly the source of differential pressure may be of any siutable nature. For immersed installations the energy is advantageously electric and may be, as soon as the depth of operation reaches a certain value, of the pressure accumulation type. The apparatus may be mechanically manipulated by an aircraft, a surface ship or a submarine vessel, for example through the medium of a hinged arm. Alternatively apparatus may be remotely controlled by flexible connections which may be also adapted to feed electric, hydraulic or other energy. Furthermore the apparatus may be built particularly for subaqueous work, so as to enjoy operative autonomy after being set into position or a full operative autonomy in which case the positioning as well as the release and the topping up to the water surface being then performed automatically. The means that are used may be easily determined by those who are skilled in the art and form, as such, no part of the invention.

For subaqueous work, the entire available space inside the apparatus may be advantageously filled with a low density material for reducing the apparent weight of the apparatus when importance is attached to increase its manoeuverability or alternatively weighted by a suitable ballast where weight can facilitate positioning. Should damage or pollution of the contacting surface be feared during preliminary manipulation or due to transportation, the fulcrum surface of the cover member and suction devices **5** may be advantageously covered with a fluid-tight skin, for example, by retraction into a specially intended space in the appaartus, said space being fitted with a suitable mechanism. Also where required, the positioning may be preceded by an improvement of the contacting surface S or a portion of this surface, for example, by injecting a cement or a similar material capable of creating a level surface, said injectiton being carried out from an independent device.

The operation of the anchoring apparatus as above described occurs as follows: In the device shown in FIG. 1, the suction devices **5** are initially extended to the maximum extent by the springs **38**, the stroke of which is so adjusted that the devices protrude from the plane of the bead **4** and the shoes of the stationary framework **1** which is itself pushed back in a similar manner of the movable frame **3** by springs **52**.

If the adhesion surface requires a preliminary sweeping action, the chamber **9** may be then subjected to an overpressure or compressed fluid pressure so as to cause an ejection or alternatively the adhesion surface may be treated, for example by an injection process as indicated in the foregoing. The chamber **9** is afterwards subjected to a vacuum or underpressure when the apparatus is applied against the ancoring surface S.

The output of the source of underpressure is so adjusted as to permit the required vacuum or underpressure to be maintained in the chamber **9** to match the leakage into suction devices **5** due to lack of fluid tightness upon the fulcrum surface S.

As soon as a device **5** is in adhering contact with the surface, the pressure is reduced in the cavity **18** and consequently in the relay **33**. This pressure reduction is operative upon the spool valve **42** to establish a communication between the chamber **36** and the vacuum or underpressure chamber **10**. The piston **35** then goes up toward the frame **3** as indicated in the foregoing while exerting upon the device **5** a tension corresponding to the vacuum or underpressure which prevails in the chamber **9**. Simultaneously through the conduit **51**, the vacuum or underpressure prevailing in the chamber **45** transmits to the framework **1** the portion of the tractional stress set by the ratio of the sectional areas of the pistons **35** and **45** and transmits to the bead **4** the difference between the two tractional stresses.

By exerting a traction upon the frame **3**, the devices **5** stimulates the anchoring of another device **5** and so on. Simultaneously the compression exerted by the bead **4** increases the fluid tightness in the area protected by the cover member **7** which is activated by the extrusion of the contact fluid contained in the network **23**, thereby facilitating creation of a vacuum or underpressure under said cover member through the conduits **25** connected with the chamber **9**.

The power of the source of vacuum or underpressure is so calculated as to maintain under the cover member **7** a sufficient underpressure to cope with the requirements even if some lack of fluid tightness or a small permeability of the support permits a limited liquid stream to flow toward the vacuum or underpressure zones. If the fluid tightness disappears locally, the corresponding device or devices **5** are released and the anchoring cycle is resumed as previously indicated.

Where the contact surfaces present symmetrically an assembly of fluid tight zones and highly pervious zones the suction devices may be advantageously provided with a contrivance ensuring their individual release following a pre-set number of unsuccessful adhesion attempts.

In order to release the apparatus, it is only required to eliminate the vacuum or underpressure prevailing in the chamber **9**. If deemed necessary, an overpressure can be also generated in said chamber for positively releasing the cover member **7** and the devices **5**.

In the showing of FIG. 2 is also represented a stationary framework **1** to which are associated three anchoring units of the aforesaid type.

In FIG. 3 is represented an annular arrangement in which the adhesion area is defined between two concentric fluid tight beads **4**, **54** defining an axial operating well. This arrangement is favourable to such work as, for example, the securement to a wall or other structure of one or several grouting bolts adapted to convert a temporary adhesion into a final adhesion. Such an operation may, regardless of the arrangement as used, be supplemented by an adhesion or cementing operation in a fashion similar to the means as used in the mining industry, thereby

opening to the anchoring apparatus according to the invention wide usage permitting the general problem of the anchoring of various appliances upon rocky sea or lake bottoms to be satisfactorily solved whether in an immerged zone or in the atmosphere.

As mentioned in the foregoing, the frame **1** may be fitted with a self-propelling system of the translational or rotary motion type. A series of compensating frames may be mounted upon an endless track capable of conveying the assembly from one site to another without causing any loss of adhesion and while providing a preliminary prospecting for the following track member.

Minor constructional details may be varied without departing from the scope of the invention.

It is to be understood that in the above description and following claims that the terms "vacuum" and "underpressure" are used to only denote a pressure less than the ambient pressure of the anchor apparatus, and are not to be limited to a pressure less than atmosphere. In fact, when the apparatus is employed underwater, the presence of atmospheric pressure within chamber **9** and devices **5** will often suffice for anchoring purposes. Accordingly, as used herein, "vacuum" and "underpressure" are intended to include all pressures less than the pressure surrounding the anchor apparatus.

What is claimed is:

1. An anchoring apparatus to be operative upon an anchoring surface and comprising at least one suction device, a source of underpressure, means interconnecting said suction device and source of underpressure during service, an impervious cover member associated with said suction device so as to define an area of application upon said anchoring surface about said suction device, a frame, an elastic suspension member having a constant tension interconnecting said suction device and frame, and clamping means disposed between said frame and cover member and applied against said cover member responsive to the tractional effect exerted between said suction device and its elastic suspension member.

2. An anchoring apparatus to be operative upon an anchoring surface and comprising a plurality of suction devices, a source of underpressure, means interconnecting said devices and said source of underpressure in service, a common impervious cover member having a periphery and associated with said devices so as to define an area of application upon said anchoring surface about said devices, a frame, elastic suspension members having a constant tension connecting said devices and said frame, and clamping means disposed between said frame and said periphery of said common cover member and applied against said cover member responsive to the tractional stress exerted between said devices and said elastic suspension members having a constant tension.

3. An anchoring apparatus to be operative upon an anchoring surface and comprising at least one suction device having a central chamber and a flexible peripheral lip having an adhesion surface defined thereon, a source of underpressure, a conduit connecting said central chamber with said source of underpressure in service, an impervious cover member having a periphery and associated with said device for defining an area of application upon said anchoring surface about said device, a frame, an elastic suspension member having a constant tension interconnecting said device and said frame, and clamping means arranged between said frame and said periphery of said cover member and applied against said cover member responsive to the tractional stress exerted between said device and said elastic suspension memebr having a constant tension.

4. An anchoring apparatus according to claim **3**, including elements having a rough anti-skidding surface defined on the adhesion surface of said device.

5. An anchoring apparatus according to claim **3**, in which said cover member has a surface directed toward said anchoring surface, primary ducts defined in said cover member surface, and secondary ducts connecting said primary ducts with said source of underpressure.

6. An anchoring apparatus according to claim **3**, wherein said cover member has a surface directed toward said anchoring surface, cells formed in said surface of the cover member, and ducts connecting said cells with said source of underpressure.

7. An anchoring apparatus to be operative upon an anchoring surface and comprising at least one suction device, a source of underpressure, a duct connecting said device with said source of underpressure in service, an impervious cover member having a periphery and associated with said device so as to define an area of application upon said anchoring surface about said device, a frame, an elastic suspension member having a constant tension interconnecting the device and frame, an adjustable hinge interposed between said device and said elastic suspension member, and clamping means disposed between said frame and said cover member periphery and applied against said cover member responsive to the tractional stress exerted between said device and said elastic suspension member having a constant tension.

8. An anchoring apparatus to be operative upon anchoring surface and comprising a plurality of suction devices, a source of underpressure, ducts connecting said devices with said source of underpressure in service, an impervious cover member having a periphery and associated with said devices for defining an area of application upon said anchoring surface about said devices, a frame, elastic suspension members having a constant tension interconnecting said devices and frame, a ball and socket type hinge interposed between each of said devices and its associated suspension member, clamping means disposed between said frame and the periphery of said cover member and applied against the cover member responsive to the tractional stress exerted between said devices and said elastic suspension members.

9. An anchoring apparatus according to claim **8**, comprising second elastic members disposed between said devices and said frame for biasing said devices away from said frame.

10. An anchoring apparatus for operation upon an anchoring surface and adapted to function in a ambient pressure medium ad comprising at least one suction device, a source of underpressure, means interconnecting said device and said source of underpressure during operation, an impervious cover member associated with said device for defining an area of application upon said anchoring surface about said device, a frame, a framework stationary relative to the anchoring surface, a first elastic suspension member disposed between said frame and framework, and clamping means disposed between said frame and said cover member applied against said cover member responsive to the tractional stress exerted intermediate said device and said elastic suspension members.

11. An anchoring apparatus according to claim **10**, wherein said elastic suspension members comprise cylinders, balancing pistons movable in said cylinders each having opposed faces, means providing communication between one face of said pistons and the ambient pressure, and second means providing communication between the other face of said pistons and said source of underpressures.

12. An anchoring apparatus according to claim **10**, wherein said elastic suspension members comprise cylinders, balancing pistons movable in said cylinders each having opposed faces, a closed fluid circuit, supply sources of different pressures included in said closed circuit, and means interconnecting the faces of said pistons with said sources of different pressures.

13. An anchoring apparatus according to claim **10**, comprising feet defined on said stationary framework and antifriction shoe elements defined on said feet and abutted against said anchoring surface.

14. An anchoring apparatus to be operative upon an

anchoring surface and comprising at least one suction device, a source of underpressure, means connecting said device with said source of underpressure during the operation of the apparatus, an impervious cover member associated with said device for defining an area of application upon said anchoring surface about said device and having a periphery, a flexible bead engaging said cover member adjacent the periphery of said cover member, a frame, and a suspension member having a constant tension interconnecting said frame and said device, and means mounted on said frame engaging said bead and applying said bead against the periphery of said cover member in accord with the tractional stress exerted between said device and said suspension member.

15. An anchoring apparatus to be operative upon an anchoring surface and comprising at least one suction device, a source of underpressure, means interconnecting said device and said source of underpressure during operation of the apparatus, a source of pressurized medium, means for providing selective connection between said suction device and said source of pressurized medium for liberating said device from the anchoring surface, an impervious cover member associated with said suction device for defining an area of application upon said anchoring surface about said device, a frame, an elastic suspension member interconnecting said device and said frame, and clamping means interposed between said frame and said cover member and applied against said cover member responsive to the tractional stress exerted intermediate said device and said elastic suspension member.

16. An anchoring apparatus according to claim **15**, comprising means for introducing a fluid capable of aiding adhesion between said suction device and the cover member.

17. An anchoring unit to be operative upon an anchoring surface and comprising sets of suction devices, a source of underpressure, means selectively interconnecting said sets of devices and said source of underpressure during operation of the apparatus, an impervious cover member associated with each set of suction devices for defining at each location an area of application upon said anchoring surface about said devices, a first frame associated with each set of suction devices, a framework, first elastic suspension members having a constant tension interposed between each frame and the associated set of suction devices, second elastic suspension members having a constant tension interposed between said frame and said framework, and clamping means interposed between each frame and the associated cover member and applied against the associated cover member responsive to the tractional stress exerted between the associated suction devices and the said elastic suspenion members.

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TRYGVE M. BLIX, Primary Examiner

U.S. Cl. X.R.

52—1; 61—46.569; 287—1