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[54] **FREE-GRAB DEVICE FOR COLLECTING UNDERWATER SAMPLES**

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[52] **U.S. Cl.** **73/425.2**

[51] **Int. Cl.** **G01n 1/08**

[58] **Field of Search** 73/425, 425.2; 294/66

[56] **References Cited**

UNITED STATES PATENTS

3,509,772 5/1970 Blair 73/425.2

3,572,129 3/1971 Walthier et al. 73/425.2

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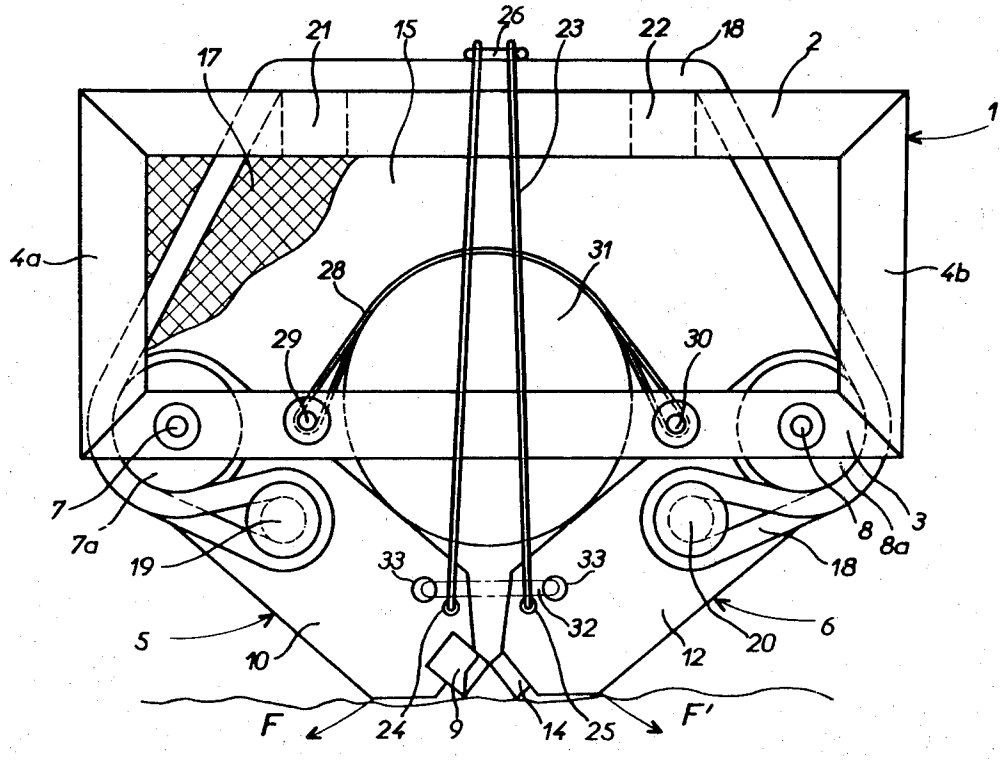
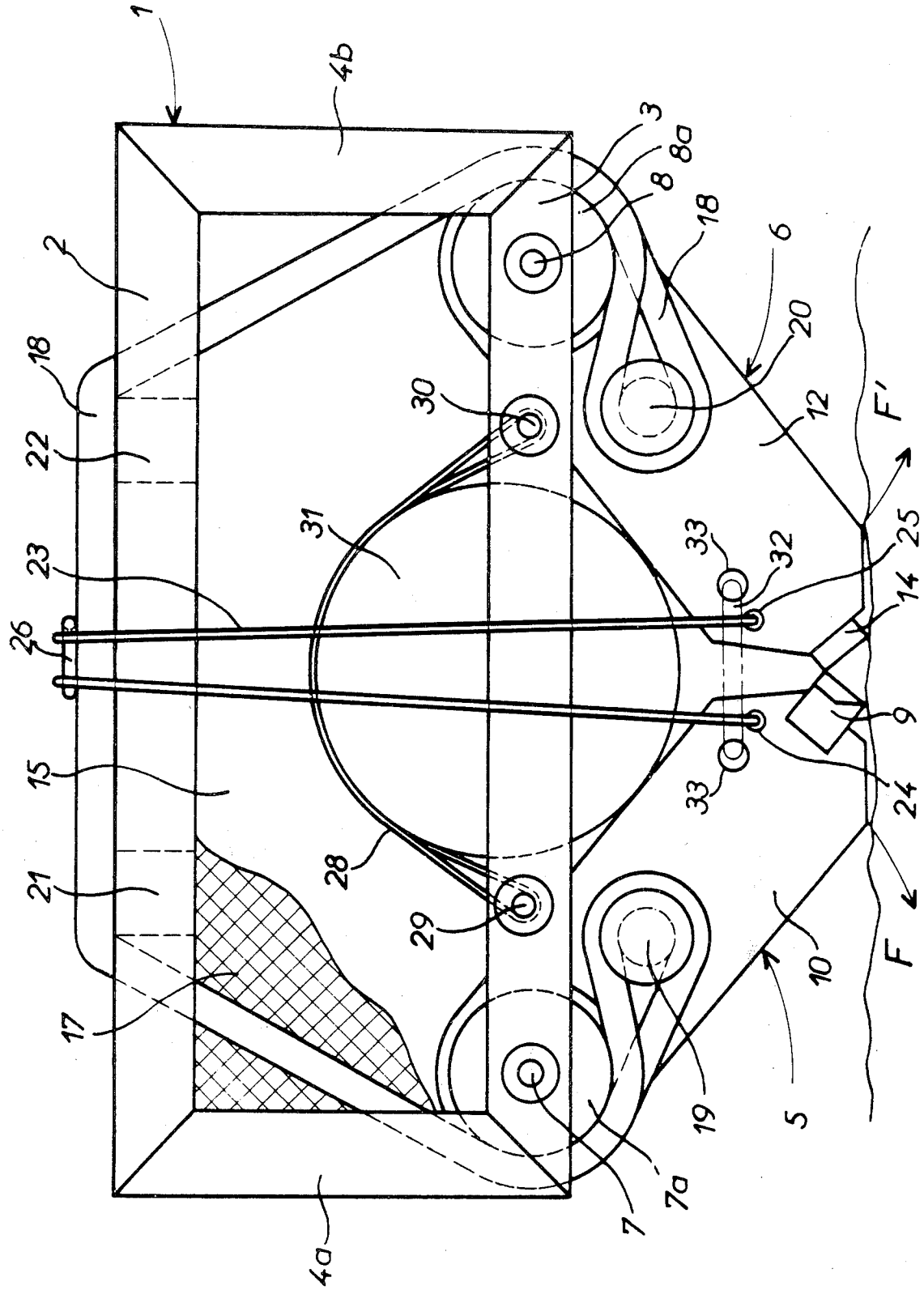
Attorney, Agent, or Firm—Fleit & Jacobson

[57] **ABSTRACT**

A free-grab device for collecting underwater samples. This device comprises a box-like frame, the bottom and two side faces of which are covered at least partially by an orificed wall, the other side faces being uncovered; two similar pick-up jaws which are fitted with scraping blades and which are pivoted on said frame to be displaceable between an open position in which they extend generally towards one another and a closed position in which they are in effective engagement with the uncovered side faces of the frame; return means acting on said jaws to urge them outwardly of said open position towards said closed position; releasable locking means acting on said jaws to lock them in said open position; and release means acting on said locking means to free said jaws when the device touches the sea-bed.

7 Claims, 1 Drawing Figure

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F'
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FREE-GRAB DEVICE FOR COLLECTING UNDERWATER SAMPLES

The present invention relates to a free-grab device for collecting underwater samples, particularly polymetallic nodules deposited on ocean beds, sometimes at very great depths which may be as much as 6,000 metres.

It is known that the expression "free-grab device" is used to designate sampling equipment which, in contrast to dredges, is released at the surface of the water without being connected to a ship or to a fixed surface installation. The free-grab device is caused to sink by a ballast which overcomes the action of one or more floats; when the device touches the sea-bed it releases the ballast automatically and, under float action, rises to the sea surface where it is recovered and where the samples contained are removed.

Known free-grab devices are of a form generally similar to that of the grab-buckets used in civil engineering operations on land, and a device of this known kind is disclosed in U.S. Pat. No. 3,572,129. These known devices suffer from a certain number of disadvantages. One disadvantage is that the jaws of the bucket often jam in a partly-closed position on touching the sea-bed, and this can allow most of the collected samples to escape. Furthermore, the ballast is cast off by means of a complicated mechanism which is not very reliable in operation.

One of the objects of the present invention is therefore to provide a free-grab device which enables a large quantity of samples to be collected in a single operation carried out in a reliable manner.

A further object of the invention is to provide a free-grab device which enables the ballast to be cast off in a simple and reliable manner.

Yet another object of the invention is to provide a free-grab device which is of simple construction and inexpensive to produce.

According to the present invention there is provided a free-grab device for collecting underwater samples, the device comprising a box-like frame, the bottom and two side faces of which are covered at least partially by an orificed wall, the other side faces being uncovered; two similar pick-up jaws which are fitted with scraping blades and which are pivoted on said frame to be displaceable between an open position in which they extend generally towards one another and a closed position in which they are in effective engagement with the uncovered side faces of the frame; return means acting on said jaws to urge them outwardly of said open position towards said closed position; releasable locking means acting on said jaws to lock them in said open position; and release means acting on said locking means to free said arms when the device touches the sea-bed.

Each of said jaws preferably comprises a cutting blade mounted between two walls pivoted on said frame, said jaws being covered at least partially by an orificed wall.

Said orificed walls advantageously comprise a net, the edges of which are secured to said frame and to said jaws.

Said resilient return means may comprise two resilient loops stretched between said jaws and passing over members secured to said frame.

Said means for locking the jaws preferably comprise two substantially non-resilient cables each of which is

secured by its ends to said jaws on the same side of the sampling device, and the two cables being interconnected at their mid zones at the upper part of the device by means of a releasable connecting member. The means for releasing the jaws may be a casting-off device of the kind described in our U.S. Pat. application Ser. No. 379,939 filed on July 17, 1973.

The device of the present invention may also include a resilient cradle mounted on said frame to hold ballast in position.

When said jaws are in the open position, they are preferably at an angle of the order of 90° to one another, said cutting blades then being substantially contiguous.

It will be appreciated from the foregoing that the jaws of the sampling device pivot outwardly during the pick-up operation, and this eliminates or at least minimises the risk of their becoming jammed on the sea-bed or jammed as a result of samples becoming jammed between the cutting blades. Also, if one jaw were to be jammed, the other should still be effective.

The ballast is cast off in a simple and reliable manner, since it is released downwardly between the jaws when they pivot outwardly.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawing which is a diagrammatic elevation, partly in section, of a free-grab device in accordance with the invention.

It should be pointed out for the purpose of clarity, that the free-grab device of the present invention will first be described in the position which it occupies upon completion of its descent to the sea-bed to collect samples, but just before it actually touches the sea-bed so that it is still in the open position. Furthermore, expressions such as "upper" and "lower" which will be used hereinafter, all relate to the positions of the various elements of the device on the assumption that the device descends vertically towards the sea-bed prior to the actual collecting operation. Furthermore, these expressions correspond to the disposition of the device that has been adopted for the purpose of the drawing, so that they will be clearly understood.

As can be seen from the drawing, the device of the invention includes a box-like frame **1** which is constructed of, for example, U-section members welded together to form upper and lower sub-frames **2** and **3** which are interconnected by vertical members **4***a*, **4***b*.

Two similar jaws **5** and **6** are pivoted about shafts **7** and **8**, respectively, which are secured to the frame **1** and each of which is located close to a short end of the lower sub-frame **3**. The shafts **7** and **8** are substantially parallel to the short ends of the sub-frame **3**.

The jaw **5** has a cutting blade **9** which extends between the end parts of two vertical walls **10**. Near their other end parts, within the frame, each wall **10** which is in the form of an elongated plate disposed near the side of the frame **1**, is formed with a hole for receiving the shaft **7**.

The jaw **6** has two walls **12** pivotally mounted on the shaft **8** and secured to a blade **14** which extends between them. The length of the various elements is so selected that, when the device is in the open position shown, the blades **9** and **14** are in contact substantially over their entire lengths. The jaws **5** and **6** take the form of a V when seen from the side, the angle of the limbs of the V being of the order of 90°.

The faces of jaws **5** and **6**, and of the lower sub-frame **3**, and the two long side faces **15** of the main frame **1**, are covered by a net, such as conventional fishing net, the size of the net openings depending on the particle-size of the sediments that are to be collected. Each of these faces can be covered by a separate piece of net, of rectangular form, the edges of the pieces being secured along the elements defining the face. Thus, for example, the piece of net covering the jaw **5** could extend between the walls **10**, the blade **9**, and the adjacent short side of the lower sub-frame **3**. However, for reasons of simplicity and for other reasons that will be explained hereinafter, it is advantageous to use a single piece of net **17** to cover all of these faces. The form of this piece of net **17** can be readily determined; it suffices for this purpose to imagine that the jaws **5** and **6** and the long side faces **15** of the frame **1** as being turned outwardly to lie in the plane of the lower sub-frame **3**. There is then obtained a cruciform area which provides the required shape, after increasing its size to give the form of a pocket. Only the edges of the net **17** are secured to the device. Starting, for example, from the blade **9** and using terminology governed by the disposition of the various elements as seen in the drawing, the net is secured to the elements in the following order: along the blade **9**, then along the rear wall **10**, the rear left-hand vertical member **4***a* of the frame, the rear edge of the upper sub-frame **2**, the rear right-hand vertical member **4***b*, the rear wall **12** of jaw **6**, the blade **14**, the front wall **12**, the front right-hand vertical member **4***b* of the frame, the front edge of the upper sub-frame **2**, the front left-hand vertical member **4***a* of the frame, and, finally, the front wall **10** of the jaw **5**.

Before the description of the mode of operation of the device of the invention, it is to be noted that, if the jaws **5** and **6** are caused to pivot outwardly about the shafts **7** and **8**, i.e., in the directions of the arrows F and F′ respectively, until the jaws move into contact with the short end faces of the frame **1**, a box-like form of net or trap is obtained which is open only at the top and is capable of retaining objects larger than the openings of the net **17**.

The device is fitted with return means which force the jaws **5** and **6** to pivot outwardly in a precise manner and to move into contact with the short end faces of the frame **1**. This return means may be constituted by a pair of resilient endless loops **18** which are advantageously made of a synthetic material such as NEOPRENE. One of the loops **18** is fitted at the front of the device and the other at its rear, and each loop passes over two pulleys **19** and **20** mounted on the wall **10** of the jaw **5** and on the wall **12** of the jaw **6**, respectively. Between these pulleys, the two strands of each loop pass on the exterior over sleeves **7***a* and **8***a* mounted, respectively, on the pivot shafts **7** and **8** of the jaws **5** and **6** and, at the top of the device, these strands pass over two transverse bars **21** and **22** secured to the upper sub-frame **2** of the main frame **1**. The length of the resilient loops **18** is, of course, such that they are firmly tensioned when fitted so that they apply to the jaws **5** and **6** a couple which tends to cause the jaws to pivot outwardly about the shafts **7** and **8** and also urge the jaws **5** and **6** firmly against the frame **1** when the device is in the closed position.

It will be appreciated that, if it is desired to hold the device in the "open" position, that is to say in the position illustrated in the drawing or in other words ready for collecting a sample, it is necessary for a counter-force to oppose the outward return action of the resilient loops **18**. This function is performed by two virtually non-resilient cables **23** which apply, one at the front and the other at the rear, an upward pull to the jaws **5** and **6** so as to keep them in position. The two ends of the front cable **23** are thus fixed, one at **24** at the lower end of the front wall **10** of the jaw **5**, and the other at **25** at the corresponding point on the front wall **12** of the jaw **6**. The lengths of the cables **23** are such that, if the front cable is held at its mid point and passed over the front edge of the upper sub-frame **2** of the main frame **1** and horizontally in the rearward direction, its mid point comes substantially into contact with the mid point of the similar cable **23** extending from the rear part of the device. It then suffices to connect the two cables firmly together for example by means of shackles **26** connected by a releasable means (not illustrated) in order to lock the jaws **5** and **6** in the open position.

Finally, a resilient cradle is formed by two loops **28**, made of, for example, NEOPRENE, which are stretched between two transverse bars **29** and **30** secured to the lower sub-frame **3** of the main frame **1**. The purpose of this cradle is to carry a cylindrical ballast element, shown diagrammatically at **31**, when the device is in the inverted position as will be described later.

The operation of the device will now be described, and for this purpose it will be supposed that it is initially in the closed position as, for example, when it has been recovered and emptied after having collected sample material.

First, the device is mounted on a rigid frame to enable it to be ready for use more easily, but inverted so that the sub-frame **2** which is in the upper position in the drawing is located at the bottom. The ballast **31** is placed in the resilient cradle **28**, the space enclosed by the net **17**, in its form described above, being employed for this purpose. The jaws **5** and **6** are then pivoted inwardly against the action of the resilient loops **18**. This operation, which may be facilitated by the use of two similar levers bearing against the sleeves **7***a* and **8***a*, is completed when the jaws **5** and **6** have moved so that the blades **9** and **14** abut against one another. The device may then be temporarily locked by passing a U-shaped pin **32** into holes **33** formed in the jaws **5** and **6**.

The device is then reinverted to bring it to its normal operating position and is lowered into the sea. The ballast **31** now rests on the walls **10** and **12** of the jaws **5** and **6**, and can be cast off after automatic release means, which have replaced the U-shaped pin **32**, disconnect the cables **23** when the device touches the sea-bed. When this occurs, the jaws **5** and **6** swing outwardly, the blades **9** and **14** scraping the sea-bed, and the sedimentary material that is to be sampled is moved by the net which covers the jaws. The material is trapped in the device when the jaws abut against the small side-faces of the frame. The ballast **31** is deposited on the sea-bed, and is generally not recoverable.

After the free-grab device has returned to the surface, the net or trap formed by the device is emptied, and the cycle can be repeated.

The metallic parts of the device according to the invention are preferably made of an aluminium alloy re-

sistant to corrosion by water, for example certain alloys of aluminium and magnesium.

What we claim is:

1. A free-grab device for collecting underwater samples, the device comprising a box-like frame, the bottom and two side faces of which are covered at least partially by an orificed wall, the other side faces being uncovered; two similar pick-up jaws which are fitted with scraping blades and which are pivoted on said frame to be displaceable between an open position in which they extend generally towards one another and a closed position in which they are in effective engagement with the uncovered side faces of the frame; return means acting on said jaws to urge them outwardly of said open position towards said closed position; releasable locking means acting on said jaws to lock them in said open position; and release means acting on said locking means to free said jaws when the device touches the sea-bed.

2. A free-grab device according to claim 1, in which each of said jaws comprises a cutting blade mounted between two walls pivoted on said frame, said jaws being covered at least partially by an orificed wall.

3. A free-grab device according to claim 1, in which said orificied walls comprise net, the edges of which are secured to said frame and to said jaws.

4. A free-grab device according to claim 1, in which said return means comprise two resilient loops stretched between said jaws and passing over members secured to said frame.

5. A free-grab device according claim 1, in which said locking means comprise two substantially non-resilient cables each of which is secured by its end to said jaws on the same side of the sampling device, and the two cables being interconnected at their mid zones at the upper part of the device by means of a releasable connecting member.

6. A free-grab device according claim 1, which comprises a releasable ballast and a resilient cradle mounted on said frame to hold said ballast in position.

7. A free-grab device according to claim 1, in which said jaws are at an angle of the order of 90° to one another, in said open position of the device, the cutting blades then being substantially contiguous.

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