B. H. COFFEY.

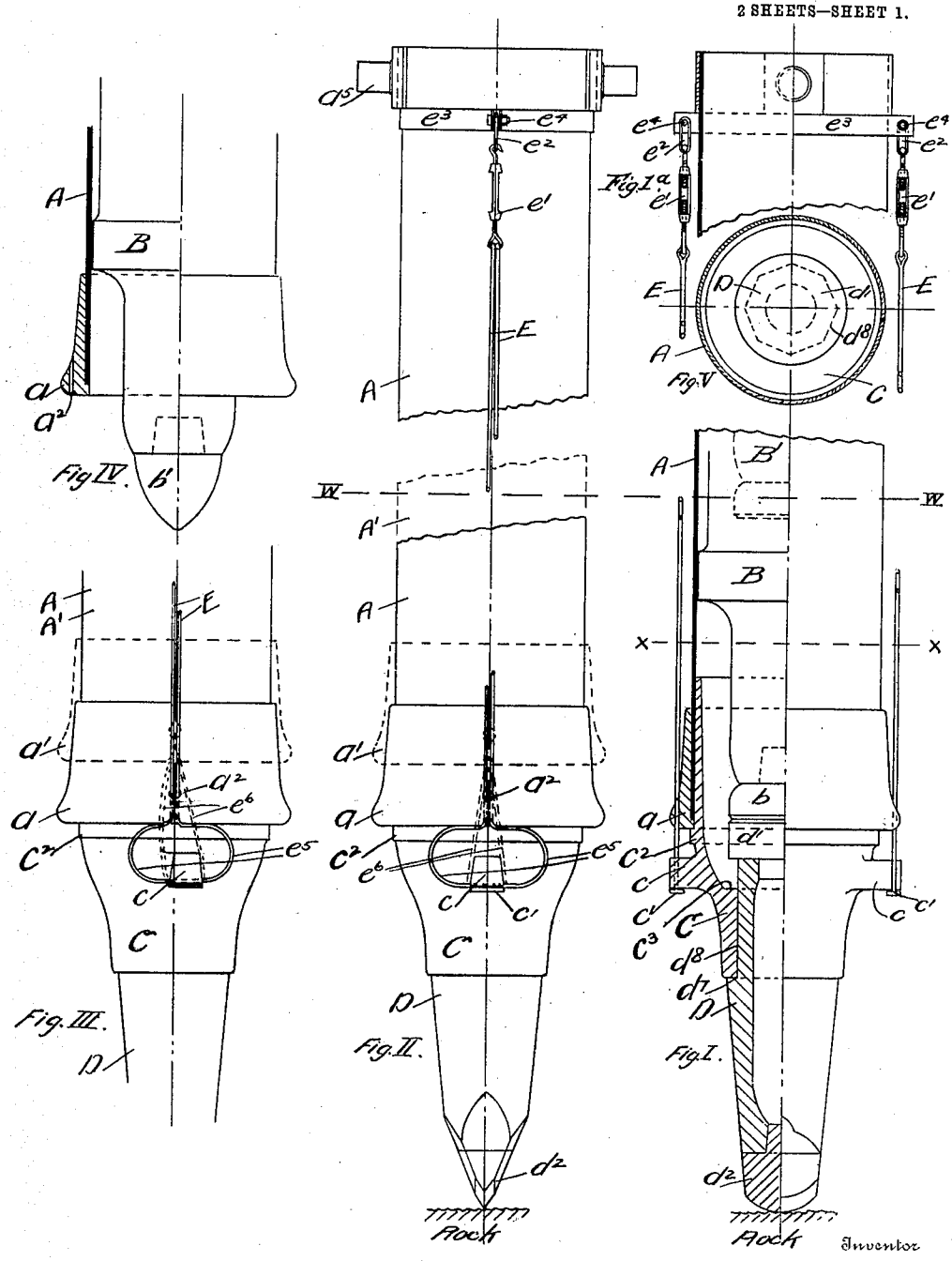
SUBAQUEOUS ROCK BREAKER.

APPLICATION FILED MAY 23, 1907.

**919,422.**

Patented Apr. 27, 1909.

2 SHEETS—SHEET 1.




Witness
Frank C. Gooding
John A. Palmer

Inventor
Benton H. Coffey.

THE NORRIS PETERS CO., WASHINGTON, D. C.

B. H. COFFEY.

SUBAQUEOUS ROCK BREAKER.

APPLICATION FILED MAY 23, 1907.

**919.422.**

Patented Apr. 27, 1909.

2 SHEETS—SHEET 2.

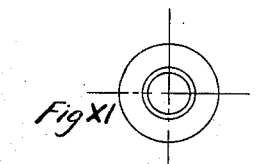


Fig XI

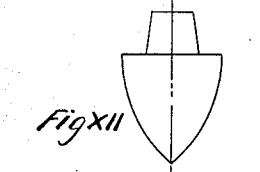


Fig XII

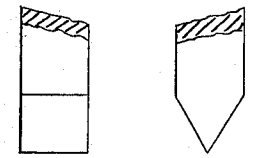


Fig XIII



Fig XIV

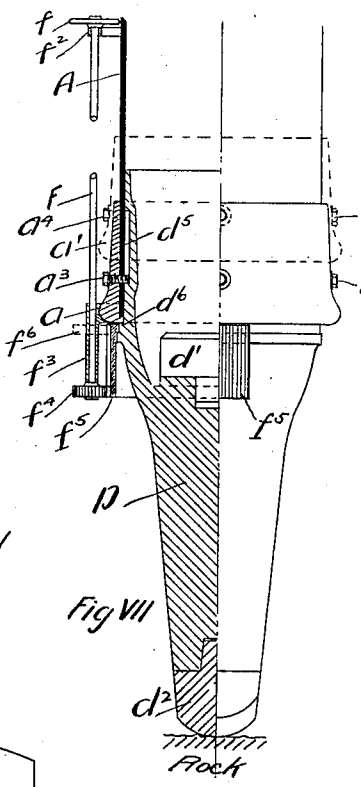



Fig VII

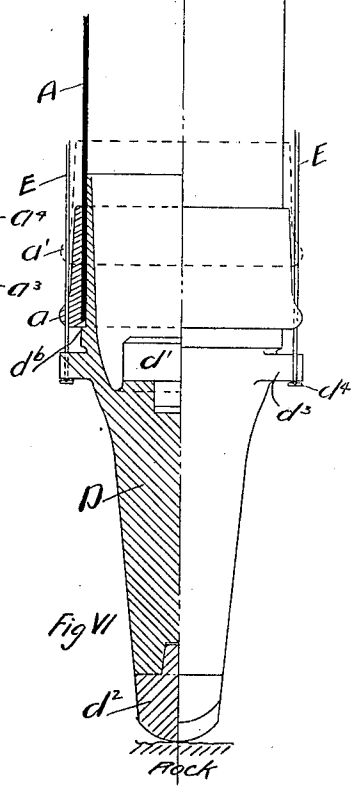



Fig VI

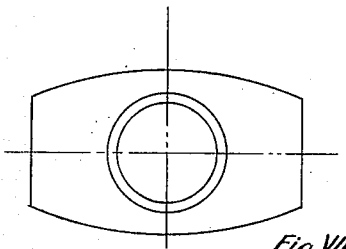


Fig VIII

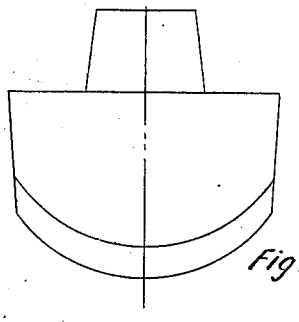


Fig IX

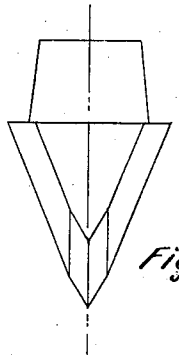


Fig X

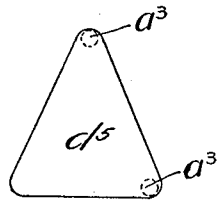



Fig. XV

Witness
Jean L. Gooding
Johnson & Kalmus

Inventor
Benton H. Coffey

THE NORRIS PETERS CO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

BARTON H. COFFEY, OF ELIZABETH, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SUBMARINE COMPANY, OF HOBOKEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

## SUBAQUEOUS ROCK-BREAKER.

No. 919,422. Specification of Letters Patent. Patented April 27, 1909.

Application filed May 23, 1907. Serial No. 375,276.

*To all whom it may concern:*

Be it known that I, BARTON H. COFFEY, a citizen of the United States, residing in Elizabeth, county of Union, State of New Jersey, have invented certain new and useful Improvements in Subaqueous Rock-Breakers, of which the following is a specification.

My invention relates to that class of subaqueous rock-breakers in which the rock-breaking machinery is surrounded by a caisson or tube from which water may be excluded; and is more especially useful where the rock-breaking energy is to be transmitted to the rock through a chisel which rests upon the rock and is struck by a reciprocating weight or hammer. Some of the features of improvement, however, are adaptable to other classes of impact rock-breakers, for example, where the chisel is dropped so as to strike the rock.

The features which are more particularly described in detail herein are intended as improvements, either generally or for specific uses upon the forms of apparatus illustrated in my prior patent No. 657,515, dated September 11, 1900, re-issued June 26, 1906, No. 12,501, and in my co-pending application, Serial No. 284,131, filed October 24, 1905.

Among the principal objects of my present invention are the following: to provide means of readily removing the rock-breaking chisel for inspection and repairs; to provide means for avoiding serious wreck or damage, as, for example, in the event of the chisel being struck by the hammer without sufficient resistance beneath the chisel to absorb the impact; to provide means whereby the weight of the chisel may be reduced to a minimum, thereby effecting maximum efficiency of impact; to provide means whereby the chisel may rotate with comparative freedom in order that it may adapt itself to inequalities of the rock while working; and means whereby it may be designedly rotated, as, for example, for the purpose of rectifying any displacement caused by its self-adaptation to the inequalities of the rock, or, in other words, return to its initial position when diverted; to provide an improved form of chisel adapted to break or split a maximum volume of rock with a minimum expenditure of energy, and possessing high wearing qualities; to provide a structure whereby the apparatus may be interchangeable so as to operate by direct impact, in a manner explained in my said re-issue patent, or indirect impact, which is employed in my said pending application, as desired, this being carried out by the use of a cutting point which can be transferred from the chisel to the hammer while at the same time removing the chisel and its appurtenances.

Other objects will appear in the reading of the following description.

I will first describe one or more specific embodiments of my invention, and then point out the novel features thereof in the claims.

In the drawings accompanying this application, Figure I is a central sectional elevation of the lower portion, and Fig. I$^a$ is a similar view of the upper portion of an apparatus embodying my improvement. Between the upper and lower portions represented on the drawing by Figs. I and I$^a$, there will be a long section of caisson or tube whose length may vary and will be determined by the conditions of use, such as depth of water. This drawing illustrates the tube or caisson, the chisel and its appurtenances, and the impact producing mechanism in the interior. The means for excluding water and the usual vessel or float having been fully described in my previous patent and application, will not be herein referred to. Fig. II is an elevation of the apparatus shown in Fig. I, looking from the left hand side thereof. Fig. III is a similar side elevation showing the chisel and appurtenances including the mouth piece, slightly rotated relatively to the caisson. Fig. IV is a partial sectional elevation of the apparatus of Fig. I when the chisel and appurtenances are removed, and instead a chisel point is attached directly to the weight moving within the caisson. Fig. V is a plan view looking downward on the plane *x*—*x*, Fig. I, with the hammer B, however, and everything outside of the caisson omitted. Fig. VI is a view similar to Fig. I of a modified form of apparatus wherein instead of a separate mouth piece the chisel is formed with an extension that performs the function thereof. Fig VII is a similar view of another modifica-

tion with different devices for effecting the retention and rotation of the chisel. Figs. VIII, IX, and X are top, side and end views respectively of a novel form of chisel point especially adaptable to subaqueous rock-breakers. Figs. XI, XII, XIII and XIV illustrate older forms of chisel point which are available for use with the improvements described in the present application. Fig. XV is a view showing a modified detail applicable to the apparatus of Fig. VII.

Similar letters of reference designate corresponding parts in the several figures of the drawing.

A represents a tube or caisson which, as explained, is intended to contain impact producing mechanism, such as a reciprocating hammer, and from which water is intended to be excluded by suitable means, such as compressed air admitted in the upper part of the caisson. The caisson may be supported or suspended in the manner indicated in my previous patents and application, from a float or vessel. Part of the suspending apparatus may comprise a gimbal pin or pivot $a^5$, Fig. II.

Surrounding the lower end of the caisson is a reinforcing ring $a$, permanently secured to the caisson. Supporting the caisson when in operation is the shoulder $c^2$ of a mouth piece C, which latter is fitted at the lower or working end of the caisson so as to be capable of a limited relative movement. It is shown as projected into the caisson with a sliding fit. Supporting the mouth piece C is the shoulder $d^7$ of a chisel D, which in operation normally rests upon the rock; and thereby the rock affords a support for the chisel, for the mouth piece, and for the caisson. The chisel D is fitted to receive relative movements through the mouth piece C in the interior of which it engages with a sliding fit. Forming the lower end of the chisel D is a chisel point $d^2$, which may be made removable or interchangeable for purposes which will hereinafter appear. The specific form of this chisel point will be more fully described and claimed. For the purposes of my invention it is desirable that the chisel D should be incapable of rotation relatively to the mouth piece C, and to effect this I have constructed the chisel of polygonal form, as will be clear from dotted lines in Fig. V.

Reciprocating within the caisson is the hammer B having the head $b$ secured at its lower end, and which is preferably removable and interchangeable. The elevated position of the hammer B is illustrated in dotted lines in Fig. I at B', and from this position its release may be effected by any suitable means so as to drop it and cause the impact upon the head $d'$ of the chisel D; which latter head is also preferably removable.

It will be seen from the above description that the blow delivered by the hammer upon the chisel head will be transmitted through the chisel D and the cutter point $d^2$ to the rock, thus effecting a penetration. The effect of such operation is to impart instantaneous movement to the chisel while the caisson and mouth piece remain at rest; but gravity at once brings the caisson and mouth piece again to their original bearing position, as before described. It is thus clear that as the point $d^2$ breaks its way downward through the rock, the caisson A and mouth piece C keep following up. The amount of relative movement between the chisel and mouth piece will depend upon the intensity of the blow delivered by the hammer and upon the resistance encountered by the chisel point. As long as this resistance is normal, then the relative movement will not exceed the distance between the face $c^3$ of the mouth piece and the lower side of the chisel head $d'$, and the relative movement of the chisel is limited between these limits. If, however, the resulting movement should exceed this limited distance, the chisel head will come in contact with the face $c^3$ of the mouth piece, and this will result in a relative movement between the mouth piece and the caisson. This, however, is something that would only result occasionally when abnormal conditions were met which resulted in an abnormal penetration for a single blow. In the extreme case that the resistance encountered should be practically nothing, for example, if a small piece of supporting rock should break away at the top of a slope, then the enormous impact of the hammer will have a tendency to carry away with it the chisel, mouth piece and anything else that will go. In order to overcome the possibility of dangerous and damaging results from this, I have in my improvement provided that the chisel and mouth piece may be carried out of the caisson without disturbing the position of the latter. The means by which I accomplish this will be hereinafter described.

On obtaining the required penetration at one point, it becomes necessary to move the rock-breaker to a fresh point. This is accomplished by lifting the chisel clear of the ledge and swinging the entire caisson over to the new point. This is accomplished through the following apparatus. Attached to the top of the caisson is a split band $e^3$, Figs. I[a] and II, having lugs at each end and bolts $e^4$ to tighten the same and to support the links $e^2$. These links, as will appear, constitute safety contrivances. Hooked into the links $e^2$ are the adjusting turn buckles $e'$, and these in turn are secured to the wire ropes E, of which I have shown two provided at diametrically opposite sides of the caisson. The ropes E pass downward through the

holes $a^2$ in the casting or band $a$, which is rigid with the caisson mouth, and the ropes are finally secured to the lugs $c$ formed upon or attached to the mouth piece C. Normally the ropes E are slack, as is clear in Figs. II and III, the slack causing them to bow, as shown at $e^5$, and this permits the relative movement before referred to between the mouth piece and the caisson.

On hoisting the caisson away from the rock for moving it to a new point, the ropes E straighten out at $e^5$, as shown in dotted lines at $e^6$, the caisson now being in the position A′ shown in dotted lines in said Figs. II and III. On further upward movement of caisson the mouth piece C is lifted, and when the lower side of the chisel head $d''$ comes in contact with the face $c^3$ of the mouth piece, the chisel is also lifted, and the caisson, mouth piece and chisel can then be moved to the new point.

While the chisel is penetrating the rock there is frequently a tendency to rotate it to a more or less degree, this being due to irregularities in rock stratification or other causes. As my apparatus is constructed, this will have a tendency to cause the mouth piece C to rotate within the caisson to a slight extent, for example, as shown in Fig. III, where the lugs $c$ are indicated as out of center. This capability of rotating is extremely valuable with an edged chisel, because it permits the same to adjust itself to the rock conditions and to best locate itself to effect a splitting of the rock.

Upon completing the penetration at a given point, and upon lifting the caisson, mouth piece and chisel to move them to a new point, the ropes E will be seen to constitute a rectifying device, having the effect of bringing the chisel back to its normal position relative to the rock and to the float. For example, if the chisel and mouth piece have been slightly rotated to the right during one of the penetrations, as seen in Fig. III, then only one of the ropes E on each side of the caisson will tighten when the latter is lifted. This is shown clearly at $e^6$, Fig. III. On further hoisting, the chisel and mouth piece, owing to their weight being eccentrically suspended in this manner, will automatically rotate back to the central position shown in Fig. II.

If the resistance opposed to the chisel should be so slight that the chisel and mouth piece were driven out of the caisson, the links $e^2$ constituting safety contrivances, being made weaker than any of the other connecting parts, would immediately break and allow the other parts to go freely with the chisel and mouth piece; this being largely due to the advantageous form of caisson mouth or its interior which is so unobstructed as to permit the hammer to drop through without tendency to displace the caisson.

When it is desired to inspect the chisel or hammer head, or to repair or attach points or heads to the chisel or hammer, it is only necessary to raise the caisson above water, hold the chisel, and unhook the adjusting turn buckles $e'$, when all parts may be removed from the caisson mouth.

In Fig. VI is a modification of my invention which differs from that shown in Fig. I principally in that instead of a mouth piece separate from the chisel D, the latter is formed with an upward extension that performs the functions of the mouth piece C. While this form is less advantageous in that it involves more weight in the shock transmitting, yet it is simpler and cheaper than the modification of Fig. I, and is susceptible of being used with the safety devices of Fig. I.

In the modification of Fig. VII is illustrated a different device for rotating the chisel back to a normal position, and a different device for limiting its outward movement relatively to the caisson. In this modification a set screw $a^3$ is employed, which constitutes not only a limiting device for limiting the outward movement of the chisel, but constitutes a safety contrivance susceptible of giving way and under abnormal strain so as to permit the hammer and chisel to drop through the mouth of the caisson without affecting the latter. In this modification is also shown a rotating means for rotating the chisel, consisting of a hand wheel $f$, which will preferably be above deck, the same being connected to a vertical shaft F, at the bottom of which is a pinion $f^4$. The shaft F rotates in a bearing $f^2$ secured to the caisson. $f^5$ represents a gear segment which is engaged by the pinion $f^4$, and being attached to the chisel D enables a deck hand to rotate the chisel by turning the hand wheel $f$. This construction is not automatic, but may afford sufficient accuracy through suitable indicators used in connection with the hand wheel by which the deck hand can properly adjust the chisel.

Instead of the hand wheel and gears, an automatic chisel adjusting or rectifying means may be employed, as illustrated in Fig. XV. This figure is intended to represent a form which may be given to the space $d^5$, Fig. VII. Normally with such an arrangement the pin $a^3$ will be located at the bottom of the space $d^5$, but when the caisson is lifted for shifting to a new position, the inclined walls of the space $d^5$, no matter what the rotation has been, will invariably bring the pin $a^3$ back to the central position shown at the upper end of said space in Fig. XV.

In Figs. XI and XII is shown a conical form of chisel point which may be attachable directly to the chisel shown in Figs. I,

II, III, VI and VII, or to the hammer shown in Fig. IV. This form of chisel point I do not now claim as new, in itself.

Figs. XIII and XIV show a form of chisel edge known as a square edge chisel, which I do not now claim as new, but which may be employed under suitable conditions with my improved apparatus.

My improved chisel which is illustrated in Figs. VIII, IX and X is one which combines the advantages of the two forms illustrated in Figs. XI, XII, XIII and XIV. Thus it retains the centering effect, or the effect of affording a central impact, which pertains to the conical point; and at the same time it retains the advantageous splitting qualities of the square edge chisel.

To these ends my chisel is formed with a curved cutting edge, as will be clear in Fig. IX, the curve being an arc of suitable form, the lowest point of which is axially located. As shown, it also contemplates curved faces above the cutting edge, as will be clear from Fig. VIII. The cutting part of such chisel point may be described as one which may be generated by moving a vertical V around an arc whose lowest point is located in line with the vertical axis of the chisel; every position of the V being preferably vertical or parallel to every other position, although slight variations would be permissible within the spirit of my invention.

What I claim as new is:

1. In a subaqueous rock-breaker, a caisson or tube, a mouthpiece movable at the working end of the tube, and a chisel longitudinally movable through the mouthpiece.

2. In a subaqueous rock-breaker, a caisson or tube, a mouthpiece movable at the working end of the tube, and a chisel longitudinally movable through the mouthpiece, combined with chisel-striking means within the tube or caisson.

3. In a subaqueous rock-breaker, the combination of a tube or caisson with an unobstructed interior, a part fitted at the mouth of said tube or caisson for limited movement relatively thereto, a chisel point or edge adapted to rest on the rock and bear the weight of said part and said tube or caisson, and impact apparatus within the tube or caisson.

4. In a subaqueous rock-breaker, the combination of a tube or caisson with unobstructed interior, a detachable part fitted at its mouth, the same held connected through means which normally permit limited longitudinal movement thereof relatively to the tube or caisson, a chisel point or edge at the bottom, and impact apparatus within the tube or caisson.

5. In a subaqueous rock-breaker, the combination of a tube or caisson with unobstructed interior, a detachable part fitted at its mouth, the same held connected through means which normally permit limited longitudinal movement thereof relatively to the tube or caisson, a chisel point or edge at the bottom, and impact apparatus within the tube or caisson, the means which holds said detachable part comprising a safety contrivance.

6. In a subaqueous rock-breaker, the combination of a tube or caisson with unobstructed interior, a detachable mouthpiece fitted at its mouth, the same held connected through means which normally permit limited longitudinal movement thereof relatively to the tube or caisson, a chisel fitted for limited movement relatively to said mouthpiece, and having a rock-breaking point or edge at the bottom, and impact apparatus within the tube or caisson.

7. In a subaqueous rock-breaker, the combination of a tube or caisson containing chisel-striking means, a longitudinally movable mouthpiece, a chisel having longitudinal movement relatively to the mouthpiece, and devices to limit the outward movements of said mouthpiece and chisel.

8. In a subaqueous rock-breaker, a caisson or tube containing chisel-striking means, a mouthpiece longitudinally movable at one end of the tube, said mouthpiece having a stop limiting its inward movement, and means for limiting its outward movement; in combination with a chisel having longitudinal movement through said mouthpiece, and stops to limit its movement.

9. In a subaqueous rock-breaker, the combination of a tube or caisson containing chisel-striking means, a chisel having longitudinal movement relatively to the working end of the tube, devices for limiting the outward movement of said chisel, and a safety contrivance associated with or comprised in said limiting devices, substantially for the purposes set forth.

10. In a subaqueous rock-breaker, the combination of a tube or caisson containing chisel-striking means, a longitudinally movable mouthpiece, a chisel having longitudinal movement relatively to the mouthpiece, and devices to limit the outward movements of said mouthpiece and chisel, one of said limiting devices having comprised in or associated with it a safety contrivance, substantially for the purposes set forth.

11. In a subaqueous rock-breaker, the combination of a tube or caisson containing chisel-striking means, a longitudinally movable mouthpiece, a chisel having longitudinal movement relatively to the mouthpiece, and devices to limit the outward movements of said mouthpiece and chisel, the limiting device for said mouthpiece having associated with or comprised in it a safety contrivance, substantially for the purposes set forth.

12. In a subaqueous rock-breaker, a caisson or tube containing chisel-striking means, combined with a chisel longitudinally movable in one end of the tube, said chisel, having a stop limiting its inward movement, means for limiting its outward movement, and a safety contrivance comprised in or associated with said limiting means, substantially for the purposes set forth.

13. In a subaqueous rock-breaker, a caisson or tube, a mouthpiece longitudinally movable in one end of the tube, said mouthpiece having a stop limiting its inward movement, means for limiting its outward movement combined with a safety-piece; in combination with a chisel having longitudinal movement through said mouthpiece, and stops to limit its movement.

14. In a subaqueous rock-breaker, the combination of a caisson or tube, an impact chisel capable of rotation relatively to said tube, and a device whereby rotation of said chisel may be effected.

15. In a subaqueous rock-breaker, the combination of a caisson or tube, an impact chisel capable of rotation relatively to said tube, and a device whereby rotation of said chisel may be effected, to bring it into normal or proper relations.

16. In a subaqueous rock-breaker, the combination of a caisson or tube, an impact chisel capable of rotation relatively to said tube, and a device whereby rotation of said chisel may be effected automatically to bring it into normal or proper relations.

17. In a subaqueous rock-breaker, the combination of a tube or caisson, a mouthpiece capable of rotation relatively thereto, a chisel carried by but incapable of rotation relatively to said mouthpiece, and a device whereby rotation of said mouthpiece with said chisel may be effected.

18. In a subaqueous rock-breaker, the combination of a tube or caisson, a mouthpiece capable of rotation relatively thereto, a chisel movable longitudinally through but incapable of rotation relatively to said mouthpiece, and a device whereby rotation of said mouthpiece with said chisel may be effected.

19. In a subaqueous rock-breaker, the combination of a tube or caisson, a mouthpiece capable of rotation relatively thereto, a chisel carried by but incapable of rotation relatively to said mouthpiece, and a device whereby rotation of said mouthpiece with said chisel may be effected to automatically bring them into proper relations.

20. In a subaqueous rock-breaker, a caisson or tube, a mouthpiece longitudinally movable at one end of the tube; in combination with a stop to limit its inward movement, and flexible attachments to limit its outward movement.

21. In a subaqueous rock-breaker, a caisson or tube, and a chisel longitudinally movable in one end of the tube; in combination with a stop to limit its inward movement, and flexible attachments to limit its outward movement.

22. In a subaqueous rock-breaker, a chisel-point having a curved cutting edge, substantially as described.

23. In a subaqueous rock-breaker, a chisel-point having a curved cutting edge, and curved faces, substantially as described.

24. In a subaqueous rock-breaker, a chisel having a working edge, said edge having a curved form with the lowest part of the curve centrally located, whereby a tendency to produce centrality of action is effected.

25. In a subaqueous rock-breaker, a chisel whose working edge is substantially of a form generated by a vertical V moved around an arc whose lowest point is located in line with the vertical axis of the chisel.

26. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same, a chisel adapted to be struck by said weight, and a part intermediate said chisel and the tube or caisson, said part with the chisel being removably connected to the caisson by means which permit longitudinal movement of said part relative to said tube or caisson.

27. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same, a mouthpiece removably connected at the working end of said tube by means which permit longitudinal movement of said mouth piece relatively to said tube, and a chisel fitted with limited longitudinal movement within the mouthpiece.

28. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same, a chisel adapted to be struck by said weight, and a part intermediate the tube and chisel said part with the chisel being removably connected to the caisson by means which permit longitudinal movement of said part relative to said tube, said means comprising flexible members as ropes.

29. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same, a chisel adapted to be struck by said weight, and a part intermediate the tube and chisel, said part with the chisel being removably connected to the caisson by means which permit longitudinal movement of said part relative to said tube, said means comprising flexible members as ropes, with hooks that may be unhooked to effect removal of said chisel and part.

30. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same, a

chisel adapted to be struck by said weight, and a part intermediate the tube and chisel, said part with the chisel being removably connected to the caisson by means which permit longitudinal movement of said part relative to said tube, said means comprising flexible members as ropes, with hooks that may be unhooked to effect removal of said chisel and part, and safety links connected with said ropes.

31. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same adaptable when desired to receive a chisel point for direct impact with rock, a removable mouthpiece at the working end of the caisson or tube, held by means which permit limited longitudinal movement thereof, and a chisel carried by the mouthpiece and adapted to be struck by the said weight for indirect impact with the rock.

32. In a subaqueous rock-breaker, the combination of a tube or caisson, a reciprocating impact weight within the same adaptable when desired to receive a chisel point for direct impact with rock, a removable mouthpiece at the working end of the caisson or tube, held by means which permit limited longitudinal movement thereof, and a chisel carried by and longitudinally movable relatively to the mouthpiece and adapted to be struck by the said weight for indirect impact with the rock.

33. In a subaqueous rock-breaker, the combination of a tube or caisson, impact apparatus including a movable weight within the tube or caisson, a movable and removable mouthpiece at the working end of said tube or caisson, a chisel body movable through said mouthpiece and removable with the latter, and a chisel-point attachable, as desired, to said chisel body, or to said movable impact weight, whereby the apparatus is rendered interchangeable for use as a direct or indirect impact rock-breaker.

In witness whereof I have hereunto affixed my hand this 22 day of May, 1907.

BARTON H. COFFEY.

Witnesses:
OLIVE B. KING,
GEO. L. WHEELOCK.