SUMMARY

[0005] According to a first aspect, there is provided an impact element, including: a single body drivable into an external element by force acting on a piston head, the single body including: a head having a front end of a narrower diameter than a rear end of the head, the head being tapered from the rear end to the front end, the front end of the head including a domed surface; a shaft having a first end integrally coupled to the head, a second end opposite the first end and a central portion interposed between the first and second ends, the second end of the shaft being operatively connectable with the piston head to define a joint located remotely from the head, and the first end of the shaft having a trailing portion with a diameter similar to that of the central portion, a leading portion with a diameter similar to that of the rear end of the head and a taper from the trailing portion to the leading portion.~~According to one aspect of the invention, an impact element is provided and includes a single body drivable into an external element by force acting on a piston head. The single body includes a head and rear ends and a shaft having a first end integrally coupled to the head, a second end opposite the first end and a central portion interposed between the first and second ends. The second end of the shaft is operatively connectable with the piston head to define a joint located remotely from the head. The first end of the shaft has a trailing portion with a diameter similar to that of the central portion, a leading portion with a diameter similar to that of the rear end of the head and a taper from the trailing portion to the leading portion.~~

[0006] According to a second aspect, there is provided a breaching apparatus, including: a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position; a firing mechanism configured to overcome the bias to move the piston head toward the fired position; and a single body impact element drivable by the movement of the piston head into an external element and including: a head having a front end of a narrower diameter than a rear end of the head, the head being tapered from the rear end to the front end, the front end of the head including a domed surface, and a shaft having a first end integrally coupled to the head, a second end opposite the first end, which is operatively connectable with the piston head to define a joint located remotely from the head, and a central portion interposed between the first and second ends, the central portion of the shaft being narrower than a rear of the head, and the first end of the shaft having a taper.~~According to another aspect of the invention, a breaching apparatus is provided and includes a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position, a firing mechanism configured to overcome the bias to move the piston head toward the fired position and a single body impact element drivable by the movement of the piston head into an external element. The single body impact element includes a head and a shaft having a first end~~

~~integrally coupled to the head, a second end opposite the first end, which is operatively connectable with the piston head to define a joint located remotely from the head, and a central portion interposed between the first and second ends. The central portion of the shaft is narrower than a rear of the head, and the first end of the shaft has a taper.~~

[0007] According to a third aspect, there is provided a breaching apparatus, including: a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position; a firing mechanism configured to overcome the bias to move the piston head toward the fired position; and a single body impact element drivable by the movement of the piston head into an external element and including a head having a front end of a narrower diameter than a rear end of the head, the head being tapered from the rear end to the front end, the front end of the head including a domed surface, and a shaft having a first end integrally coupled to the head, a second end operatively connectable with the piston head to define a joint located remotely from the head and a central portion interposed between the first and second ends.~~According to yet another aspect of the invention, a breaching apparatus is provided and includes a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position, a firing mechanism configured to overcome the bias to move the piston head toward the fired position and a single body impact element drivable by the movement of the piston head into an external element. The single body impact element includes a head and a shaft having a first end integrally coupled to the head, a second end operatively connectable with the piston head to~~

~~define a joint located remotely from the head and a central portion interposed between the first and second ends.~~

[0008] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0010] FIG. 1 is a breaching apparatus in accordance with embodiments;

[0011] FIG. 2 is a side view of an impact element of the breaching apparatus in accordance with embodiments;

[0012] FIG. 3 is an enlarged view of a portion of the impact element of FIG. 2, which is encircled by circle "A"; and

[0013] FIG. 4 is an enlarged view of another portion of the impact element of FIG. 2, which is encircled by circle "B".

[0014] The detailed description explains embodiments of the invention, together with advantages and features, by way of example with reference to the drawings.

DETAILED DESCRIPTION

[0015] With reference to FIG. 1, a controlled impact rescue tool (CIRT) 10 is provided. The CIRT 10 is described in detail in US Patent No. 7,814,822, the entire contents of which are incorporated herein by reference. As a general matter, the CIRT 10 includes a housing 20, a firing mechanism 30 and a single body impact element 40. The housing 20 is formed to define a tunnel 21 and includes a piston head 22 and a biasing unit 23. The piston head 22 is movable through the tunnel 21 between a loaded position, at which the piston head 22 is prepared to be fired, and a fired position, at which the piston head 22 is located

CLAIMS:

1. An impact element, comprising:

a single body drivable into an external element by force acting on a piston head, the single body comprising:

a head; and

a shaft having a first end integrally coupled to the head, a second end opposite the first end and a central portion interposed between the first and second ends,

the second end of the shaft being operatively connectable with the piston head to define a joint located remotely from the head, and

the first end of the shaft having a trailing portion with a diameter similar to that of the central portion, a leading portion with a diameter similar to that of the rear end of the head and a taper from the trailing portion to the leading portion.

2. The impact element according to claim 1, wherein the taper is a curvilinear taper.

3. The impact element according to claim 1 or 2, wherein a front end of the head has a narrower diameter than the rear end of the head, the head being tapered from the rear end to the front end.

4. The impact element according to claim 1, wherein a front end of the head comprises a domed surface.

5. The impact element according to any preceding claim, further comprising threading formed on an exterior surface of the second end of the shaft such that the second end of the shaft is threadably engageable with the piston head.

6. The impact element according to any preceding claim, further comprising a locking unit disposed at the second end of the shaft.

7. The impact element according to any preceding claim, wherein the rear end of the head comprises a shallow tapered chamfer.

8. A breaching apparatus, comprising:

a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position;

a firing mechanism configured to overcome the bias to move the piston head toward the fired position; and

a single body impact element drivable by the movement of the piston head into an external element and including:

a head and a shaft having a first end integrally coupled to the head, a second end opposite the first end, which is operatively connectable with the piston head to define a joint located remotely from the head, and a central portion interposed between the first and second ends, the central portion of the shaft being narrower than a rear of the head, and the first end of the shaft having a taper.

9. The breaching apparatus according to claim 8, wherein the taper is a curvilinear taper.

10. The breaching apparatus according to claim 8 or 9, wherein the head is tapered.

11. The breaching apparatus according to any one of claims 8 to 10, further comprising threading formed on an exterior surface of the second end of the shaft such that the second end of the shaft is threadably engageable with the piston head.

12. The breaching apparatus according to any one of claims 8 to 11, further comprising a locking unit disposed at the second end of the shaft.

13. The breaching apparatus according to any one of claims 8 to 12, wherein the rear of the head comprises a shallow tapered chamfer.

14. A breaching apparatus, comprising:

a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position;

a firing mechanism configured to overcome the bias to move the piston head toward the fired position; and

a single body impact element drivable by the movement of the piston head into an external element and including a head and a shaft having a first end integrally coupled to the head, a second end operatively connectable with the piston head to define a joint located remotely from the head and a central portion interposed between the first and second ends.

15. The breaching apparatus according to claim 14, wherein the first end of the shaft has a curvilinear taper.

16. The breaching apparatus according to claim 14 or 15, wherein respective exterior surfaces of the first end and the central portion of the shaft present a smooth interface.

17. The breaching apparatus according to any one of claims 14 to 16, wherein the head is tapered.

18. The breaching apparatus according to any one of claims 14 to 17, further comprising threading formed on an exterior surface of the second end of the shaft whereby the shaft is threadably engageable with the piston head.

19. The breaching apparatus according to any one of claims 14 to 18, further comprising a locking unit disposed at the second end of the shaft.

20. The breaching apparatus according to any one of claims 14 to 19, wherein a rear end of the head comprises a shallow tapered chamfer.

CLAIMS:

1. An impact element, including:

a single body drivable into an external element by force acting on a piston head, the single body including:

a head having a front end of a narrower diameter than a rear end of the head, the head being tapered from the rear end to the front end, the front end of the head including a domed surface;

a shaft having a first end integrally coupled to the head, a second end opposite the first end and a central portion interposed between the first and second ends,

the second end of the shaft being operatively connectable with the piston head to define a joint located remotely from the head, and

the first end of the shaft having a trailing portion with a diameter similar to that of the central portion, a leading portion with a diameter similar to that of the rear end of the head and a taper from the trailing portion to the leading portion.

2. The impact element according to claim 1, wherein the taper of the shaft is a curvilinear taper.

3. The impact element according to claim 1 or claim 2, further including threading formed on an exterior surface of the second end of the shaft such that the second end of the shaft is threadably engageable with the piston head.

4. The impact element according to any one of the preceding claims, further including a locking unit disposed at the second end of the shaft.

5. The impact element according to any one of the preceding claims, wherein the rear end of the head includes a shallow tapered chamfer.

6. A breaching apparatus, including:

a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position;

a firing mechanism configured to overcome the bias to move the piston head toward the fired position; and

a single body impact element drivable by the movement of the piston head into an external element and including:

a head having a front end of a narrower diameter than a rear end of the head, the head being tapered from the rear end to the front end, the front end of the head including a domed surface, and a shaft having a first end integrally coupled to the head, a second end opposite the first end, which is operatively connectable with the piston head to define a joint located remotely from the head, and a central portion interposed between the first and second ends, the central portion of the shaft being narrower than a rear of the head, and the first end of the shaft having a taper.

7. The breaching apparatus according to claim 6, wherein the taper of the shaft is a curvilinear taper.

8. The breaching apparatus according to claim 6 or claim 7, further including threading formed on an exterior surface of the second end of the shaft such that the second end of the shaft is threadably engageable with the piston head.

9. The breaching apparatus according to any one of claims 6 to 8, further including a locking unit disposed at the second end of the shaft.

10. The breaching apparatus according to any one of claims 6 to 9, wherein the rear of the head includes a shallow tapered chamfer.

11. A breaching apparatus, including:

a housing defining a tunnel and including a piston head movable through the tunnel between a loaded position and a fired position and a biasing unit configured to bias the piston head to remain in the loaded position;

a firing mechanism configured to overcome the bias to move the piston head toward the fired position; and

a single body impact element drivable by the movement of the piston head into an external element and including a head having a front end of a narrower diameter than a rear end of the head, the head being tapered from the rear end to the front end, the front end of the head including a domed surface, and a shaft having a first end integrally coupled to the head, a second end operatively connectable with

the piston head to define a joint located remotely from the head and a central portion interposed between the first and second ends.

12. The breaching apparatus according to claim 11, wherein the first end of the shaft has a curvilinear taper.

13. The breaching apparatus according to claim 11 or claim 12, wherein respective exterior surfaces of the first end and the central portion of the shaft present a smooth interface.

14. The breaching apparatus according to any one of claims 11 to 13, further including threading formed on an exterior surface of the second end of the shaft whereby the shaft is threadably engageable with the piston head.

15. The breaching apparatus according to any one of claims 11 to 14, further 15 including a locking unit disposed at the second end of the shaft.

16. The breaching apparatus according to any one of claims 11 to 15, wherein a rear end of the head includes a shallow tapered chamfer.