

E. LEFEVER & J. A. BREMNER.

SHELL FOR HIGH EXPLOSIVES.

No. 476,395.

Patented June 7, 1892.

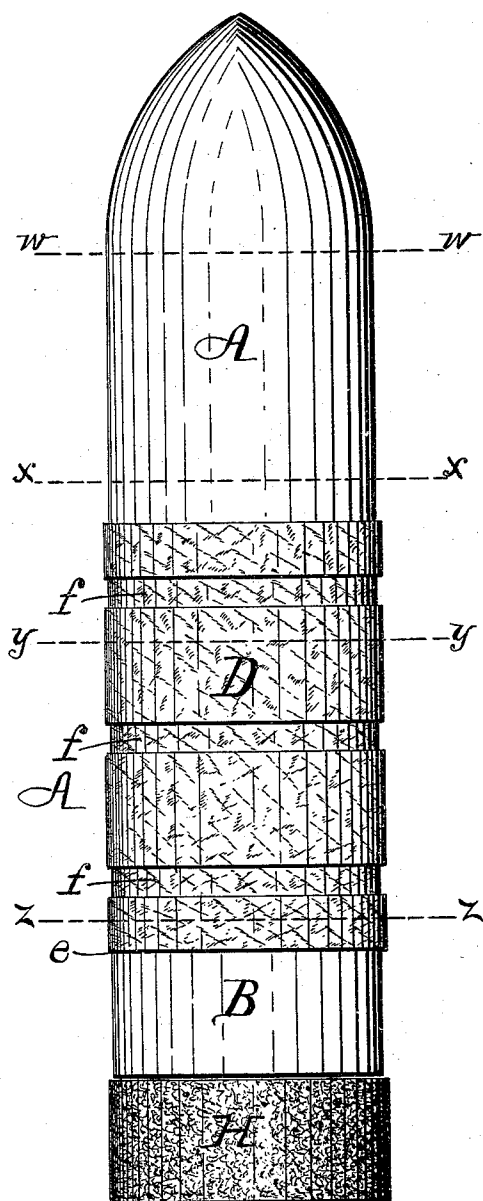


FIG-1-

ATTEST-

E. K. L. M. L.
E. Butler

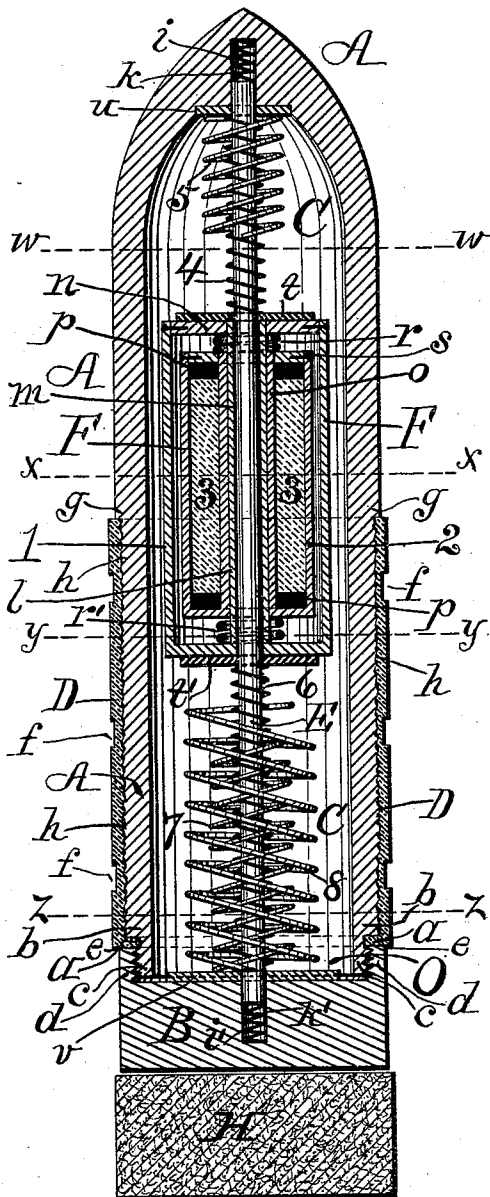


FIG-2-

INVENTORS-

Edward Lelever, Jr.
John A. Bremner,
per E. C. Raymond, their Atty.

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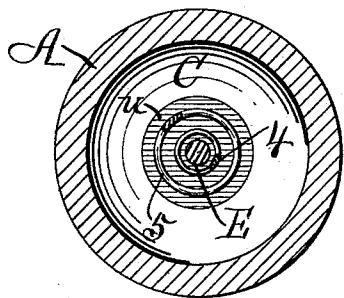


FIG-3-

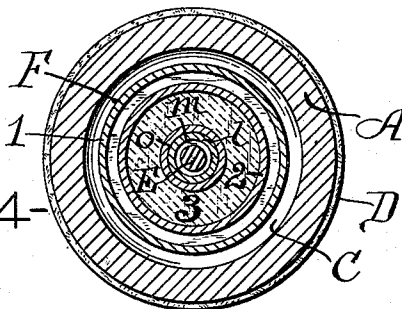


FIG-4-

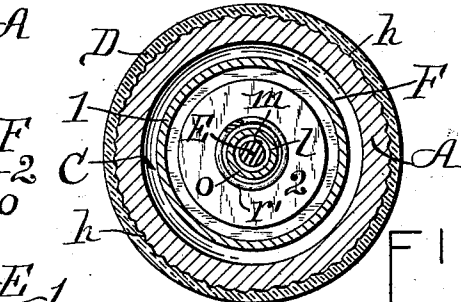
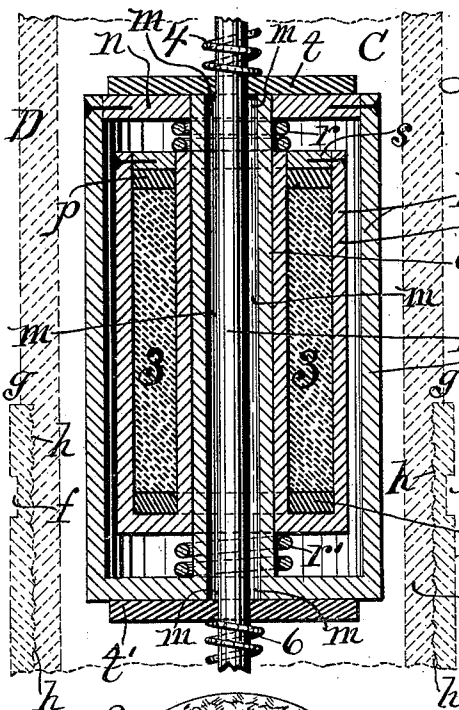


FIG-5-

FIG-6-

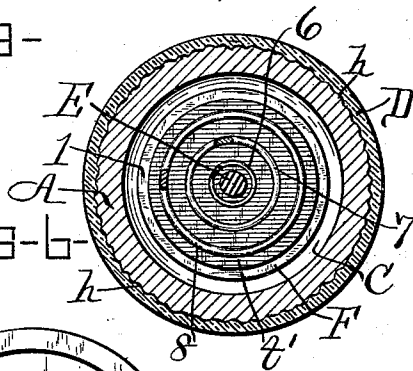


FIG-7-

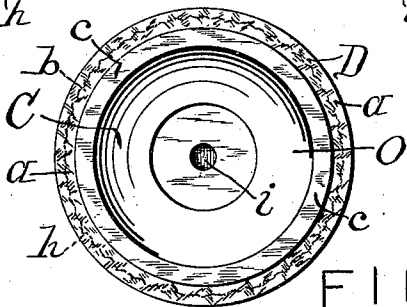


FIG-8-

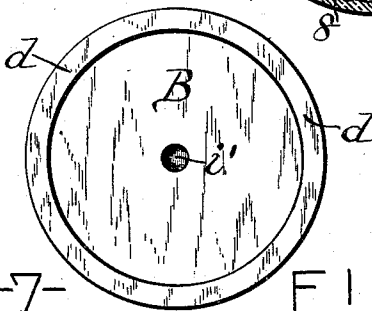


FIG-9-

Witnesses—

E. Butler

Irwin Sears

Inventors—

Edward Lefever, and
John A. Bremner,
By their Attorney—
Wm C. Raymond.

UNITED STATES PATENT OFFICE.

EDWARD LEFEVER AND JOHN A. BREMNER, OF SYRACUSE, NEW YORK.

SHELL FOR HIGH EXPLOSIVES.

SPECIFICATION forming part of Letters Patent No. 476,395, dated June 7, 1892.

Application filed November 12, 1890. Serial No. 371,257. (No model.)

To all whom it may concern:

Be it known that we, EDWARD LEFEVER and JOHN A. BREMNER, citizens of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have jointly invented certain new and useful Improvements in Shells for High Explosives; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, in which—

Figure 1 is an elevation of our shell complete; Fig. 2, a central longitudinal section of the same; Fig. 3, a transverse section taken on lines *w w*, Figs. 1 and 2; Fig. 4, a transverse section taken on lines *x x*; Fig. 5, a similar section taken on lines *y y*; Fig. 6, a like section taken on lines *z z*; Fig. 7, a view of the breech or rearward end of the shell-body with internal portions removed; Fig. 8, an interior plan of the breech-piece or cap detached from the breech of the shell-body; and Fig. 9 is an enlarged detail representing in central and longitudinal section the explosive-carrier erected in position upon its guide and supporting rod, and conjointly, by dotted lines or work, is represented, on like section, a portion of the surrounding wall of the shell-body.

Similar letters and figures of reference denote corresponding parts throughout the several views of the drawings.

Our invention relates to the construction of shells designed for firing high explosives from cannon.

Our object is the construction of a shell of the class described capable of carrying heavy charges of dynamite or other high explosive and to furnish the shell such protection from the shock incident to the explosion of the powder as shall absolutely prevent premature explosion of the explosive.

Our invention consists in the several novel features of construction and operation hereinafter described, and which are specifically enumerated in the several clauses of claims hereunto annexed.

It is constructed as follows:

A is the body proper of the shell, formed of an integral piece of hard metal (preferably

cast, wrought, or block steel) and of tubular form longitudinally, usually conical or slightly rounded at its forward end, and open (until closed) at its breech portion, the diameter of the body's circumferential chamber.

B is a thick breech-piece or closing-cap formed of hard metal, screwed or otherwise removably secured to the breech of the body of the shell and tightly closing the opening O of the chamber C therein.

D is a jacket composed of lead or other soft metal, circumferentially inclosing the periphery of the body A a suitable distance longitudinally, and preferably starting at about midway the body's length and extending to the breech or rear extremity thereof and terminating thereat in an annular flanged or rimmed portion *a*, abutting horizontally against the external peripheral-shouldered portion *b* of the shell-body A, whence starts the exteriorly reduced or contracted externally-threaded extremity *c* of the breech portion of the body of the shell, and whereby the breech-piece B, having forwardly the internally-threaded circumferentially-flanged portion *d*, is attachable to the threaded extremity *c* of the body and at its front edge pressing against and accommodating itself to the pliable or yielding soft metal flange *a* of the jacket D and at the point of union or contact therewith forming a perfect air and gas tight joint, as indicated at *e*. It is obvious that the flanged threaded portion *d* of the breech-piece B, circumferentially inclosing the tubular threaded extremity *c* of the shell's body, retains the same securely against lateral strain and pressure, or, in other words, from bulging outwardly when subjected to service. The peripheral surface of the soft-metal jacket or envelope D projects sufficiently outward beyond the periphery of the hard-metal body portion A to closely fit within the bore of a cannon, and thereby retaining centrally and practically in non-contact with the gun interior the hard-metal body proper of the shell. This jacket D is provided with annular or circumferential lubricator-grooves *f*, (or other requisite indentations or depressions,) entering partially into the soft-metal jacket, the aforesaid grooves being disposed at preferred or stated distances apart accordingly as desired. The external surface of the body of the shell A, whereat it

is to be inclosed by the soft-metal jacket aforesaid, is slightly reduced in size circumferentially and creating an annular shoulder or offset g , which, in connection with the pecked or otherwise roughened or uneven circumferential surface of the shell-body thereat, as indicated by the letter h , at various points insures a firm grip or hold for the jacket D, (usually molded thereto,) the soft metal necessarily entering into the depressions or inequalities of said surface, and thus, in connection with the hard-metal shoulder g of the body, against which it abuts at its forward edge, is firmly and immovably held to the body A and liability of displacement therefrom either longitudinally or laterally effectively prevented.

Centrally and longitudinally within the extended chamber C, created by the tubular body of the shell, we erect a guide or supporting rod E, preferably of cast-steel, extending from end to end of said chamber and secured forwardly within a circular cavity i of slightly larger diameter than the rod, formed centrally in the forward end of the body, said rod extremity partially entering same and abutting against a short coiled spring k , disposed at the closed end of the cavity and partly occupying same lengthwise, and the rear end of the guide or supporting rod partially enters and abuts against a similar coiled spring k' , lying within a corresponding cavity i' , formed in the inner face of the detachable breech-piece B and lineally with the companion cavity i at the forward extremity of the chamber C. The function of the aforementioned springs k k' is to relieve the rod E of sudden or excessive jar or vibration and insuring easy play of same longitudinally when the shell is discharged from a cannon. Upon said guide or supporting rod E we centrally and longitudinally mount an explosive-carrying cylinder or carrier F, normally resting slightly forward of the middle point of the chamber C, and being of smaller diameter than said chamber C is in absolute non-contact at all points with the surrounding chamber-wall, said explosive-carrying cylinder or carrier F comprising, conjointly, an outer cylinder 1 and a cylinder 2, of less diameter and shorter length, inclosed therein, said inner cylinder 2 (in which the dynamite or other high explosive is placed) being disposed in absolute non-contact with the surrounding wall of the inclosing cylinder 1 of the cylindrical carrier F. Each of these cylinders 1 and 2, comprising, respectively, a body portion and an end cover, we preferably construct of wood or other non-vibratory material. The central tube l of the cylinder 1, creating an annular chamber thereto, is also preferably formed of wood or other non-vibratory material and extending longitudinally from end to end thereof (and rigidly secured thereto at its rear end) is formed of sufficient circumference to entirely clear the inclosed guide or supporting rod E, whereby an annular open

space m is created, and thus, being in absolute non-contact therewith, frictionless longitudinal movement thereon is positively assured. The forward annular opening of the cylinder 1 is provided with a cover n , secured in place by screws or other satisfactory means.

Within the cylinder 1 we place the smaller and explosive-charged cylinder 2, said cylinder being also provided with a central tube o , attached to the cylinder's rear end or head, and formed by preference of wood or other non-vibratory material and extending from end to end of the cylinder and being of sufficient diameter to movably inclose or surround the central longitudinal tube l of the outer cylinder 1 of the explosive-carrier F. Within the interior cylinder 2 of the aforesaid carrier is packed the explosive 3, there being interposed between said explosive and the ends of the inner cylinder 2 a packing p of felt or other suitable elastic or pliable material. This inner cylinder 2, (of annular form transversely,) in which the explosive is placed and which is of less length longitudinally than the outer inclosing cylinder 1, is provided upon the outer face of its respective ends or heads with spiral compensating springs r r' , encircling the tubular portion l of the cylinder 1 and extending from the exterior face of the ends of the cylinder 2 to and against the inner face of the ends of the inclosing cylinder 1 and serving the function of an elastic bearing or easement between the said mentioned parts. Said afore-described interior cylinder 2 is provided with a cover s to its annular forward opening, secured in position by screws or other suitable means, connecting said cover with the body of the cylinder.

t t' are elastic washers of leather, rubber, or other suitable elastic material, cemented or otherwise firmly attached to the external face of the front and rear ends of the outer cylinder 1 of the explosive-carrier F, said washers having a central aperture and fitting snugly around the periphery of the guide and supporting rod E.

4 is a spiral spring encircling the forward portion of the guide or centering rod E and extending from a centrally-perforated disk u , (preferably metallic,) disposed at the forward extremity of the chamber C of the body of the shell, against which it lies, rearwardly to and in direct contact with the washer t upon the cover of the cylinder 1 of the explosive-carrier and attached securely to the disk u aforementioned, then extends rearwardly partially the length of the coiled spring 4, a heavier and stiffer coiled spring 5, the helices thereof surrounding in non-contact the smaller spring 4, and thereby insuring perfect freedom of movement of either of the springs irrespective of the degree of compression or expansibility one or the other may undergo longitudinally.

6 is a spiral spring corresponding in diameter to the spring 4, aforementioned, but of some-

what greater length, and which encircles the guide or supporting rod E and extending from the washer *t'* on the exterior face of the rear extremity of the cylinder 1 rearwardly to and
 5 against a centrally-perforated disk *v*, (preferably metallic,) inclosing the rod E, the said disk lying on or against the interior face of the breech-piece B, secured to the breech of the body of the shell, and 7 is a heavier and
 10 stiffer coiled spring encircling in non-contact the smaller spring 6, while 8 is a still heavier and stiffer coiled spring inclosing in non-contact the spring 7 aforementioned, and the helices of one spring not interfering with the
 15 helices of the adjacent spring perfect freedom of movement longitudinally is insured. The spring 7 extends from the disk *v* (to which it is attached) forwardly in near proximity to the washer *t'* on the head of the cylinder 1, and the spring 8 (also attached to the disk
 20 aforesaid) extends forwardly a slightly less distance. As is obvious, the smaller springs 4 and 6, pressing from opposite directions lightly against the adjacent ends of the cylinder 1 of the explosive-carrier, serves to normally retain same upon the rod E at a point
 25 slightly forward of the center of length of the chamber C, and serving, also, to retain the disks *u* and *v* in place.

30 It is a wad, of disk shape and of considerable thickness, formed of felt or other suitable compressible or elastic material disposed adjacent to (or, when preferred, secured directly to) the outer rear face of the breech-piece B and is of sufficient circumference to slightly project beyond the periphery of the breech-piece B and lineally with the peripheral surface of the soft-metal jacket D upon the body of the shell. This wad H, of slightly greater
 40 circumference than the body of the shell and its breech-piece B and of equal circumference with the jacket D, serves in quite a degree to offset the first or primary shock from the explosion of the gunpowder against which the wad has been placed, the said wad taking
 45 up the recoil and shutting off escaping gases generated by the explosion of the powder. The soft-metal jacket D, which, like the wad H, is of the exact circumference to closely fit the bore of the cannon for which it is intended will, it is evident, not only readily take the rifling of the cannon, but also instantaneously conform or adapt itself to any inequalities or slight projections that might exist within the
 55 bore of the cannon, the soft-metal jacket obviously presenting no resistance thereto, incidental to the passage of the shell along the bore of the gun. Moreover, the jacket D serves to center and retain lineal the body proper of the shell while resting in the bore of a cannon and during its propulsion therein.

60 Although, by way of exemplification, we herein illustrate the body proper of the shell provided with a soft-metal jacket of such external configuration as to especially render our shell suitable for service in a smooth-bore cannon, it is correspondingly and equally ap-

plicable for usage in a rifled cannon by merely so configuring the peripheral surface of the jacket that it will correspond to the rifling of the bore of the gun. As is evident, the various and differently located springs utilized in the construction of our shell serve as a positive and reliable cushioning for the parts entering into the formation of the explosive-carrier.

It is obvious that by reason of our novel manner of construction and the arrangement of the several parts entering into the formation of our shell, the body of the shell, the explosive-carrier, or the cylinders comprising said carrier are clearly adapted to take on a rotary motion, either singly or collectively, and to rotate in a like direction or in opposite directions, or one or more remain perfectly stationary so far as rotation is concerned, while one part spins or rotates upon its axis, all depending upon the specific revolution or rotary movement or movements which may be imparted to the aforementioned parts incidental to the discharge of the shell from out a rifled cannon, the rifling of the bore of the cannon necessarily imparting or causing a rotary movement to the shell in its passage through it.

Our usual method of procedure for inserting the explosive within the body of the shell, first having placed the explosive and end packing in the smaller or explosive-charged cylinder 2 of the carrier, securing the end cover thereof in position, and then disposing said internal cylinder in position within the external cylinder 1 of the carrier, the coiled springs *r* *r'* being correctly placed and the end cover thereof secured in position, is substantially as follows: First, the guide and supporting rod E (that centers the explosive-carrier within the chamber of the shell) is inserted through the open breech forwardly along the chamber C and entering the cavity
 100 *i* at the further extremity of said chamber and pressing against the spring *k* therein. Next the small spring 4 and heavier spring 5 are slipped onto the guide-rod E and projected forwardly in position. Next the explosive-carrier (comprising the internal and external cylinders 1 2) is slipped centrally along the guide-rod. Next the rearward springs 6, 7, and 8 are slid along the rod E into position, and, lastly, the breech-piece B is firmly attached to the breech end of the body of the shell, the rear end of the guide and carrying rod centering at and partially entering the spring-provided cavity *i'*. When the shell is within the bore of a cannon, the wad H lies
 125 against the gunpowder therein and the breech-piece of the shell, abutting against the aforesaid wad. The ignited powder (or the impetus thereof) acting on the wad and indirectly the breech-piece of the shell will have a tendency to or the effect of causing the cylindrical carrier F to move rearwardly, and accordingly as it moves backward the rear coiled springs 6, 7, 8, and *k'* take up all the

recoil resultant from concussion. The elastic washers $t t'$, fitted to the end of the cylinder 1 of the carrier and snugly fitting the rod E, prevent vibrations extending to the chambers of the carrier-body and absolutely preventing frictional contact thereof with carrying and supporting rod E, extending through the same. Upon the back recoil the forward springs 4, 5, and k serve as a cushioning for the carrier and taking up said return recoil, the rearward springs expanding and following up the said carrier-body F. The explosive-carrier being centrally and freely suspended, it is apparent that said arrangement, in conjunction with the other novel and salient features embodied in our manner of construction, renders it impossible when the ignited powder acts upon the shell-body for any friction or vibration of the body of the shell to be transmitted to the chambers of the explosive-carrier.

Practical tests and experiments made by us with our shell have demonstrated to our satisfaction the immunity thereof from premature explosion within the bore of a cannon.

It is obvious that the open-air chamber, in which the cylinder 1 of the explosive-carrier is disposed, and the interior open-air chamber surrounding the explosive-charged cylinder 2 thereof, operate to protect the carrier (and its internal parts) from the heat of the gunpowder. The wad H also serves to a large degree a like purpose.

Having described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the body of the shell, of an explosive-carrier disposed centrally within the bore or chamber thereof of less diameter than said bore or chamber and cushioned solely at its ends, as shown, whereby said explosive-carrier will be out of contact with and disconnected from the encircling inner surface of the body, substantially as and for the purposes specified.

2. The combination, with the body of the shell, of an explosive-carrier disposed centrally within the bore or chamber thereof and comprising an inner and an outer cylinder, said cylinders being cushioned solely at their ends, and said outer cylinder being of less diameter than the bore or chamber of the body of the shell and said inner cylinder of less diameter than said outer cylinder, as shown, whereby the outer cylinder will be out of contact with and disconnected from the encircling inner surface of the body and said inner cylinder out of contact with and disconnected from the encircling wall of the outer cylinder.

3. The combination, with the body of the shell, of the explosive-carrier mounted within the chamber of the body upon a support extending from end to end of the chamber and adapted to longitudinal movement thereon, substantially as described.

4. The combination, with the body of a shell,

of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod, and cushions for said explosive-carrier.

5. The combination, with the body of the shell, of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod, and a plurality of coiled springs of varied diameter and thickness encircling said rod at either end thereof and serving as elastic cushions for said explosive-carrier, substantially as described.

6. The combination, with the body of the shell, of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod, but in non-contact therewith, and cushions for said explosive-carrier.

7. The combination, with the body of the shell, of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod, but in non-contact therewith, and a plurality of coiled springs of varied diameter and thickness encircling said rod at either end thereof and serving as elastic cushions for said explosive-carrier, substantially as described.

8. The combination, with the body of the shell, of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod and comprising an inner and an outer cylinder, said cylinders being in non-contact with each other and said inner cylinder being in non-contact with said rod and said outer cylinder with the encircling inner surface of the body of the shell, and elastic cushions for said explosive-carrier.

9. The combination, with the body of the shell, of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod and comprising an inner and an outer cylinder, said cylinders being in non-contact with each other and said inner cylinder being in non-contact with said rod and said outer cylinder with the encircling inner surface of the body of the shell, elastic cushions for said inner cylinder, interposed between the ends of said inner and outer cylinders and in contact therewith, and elastic cushions for said outer cylinder interposed between the same and the end walls of the shell.

10. The combination, with the body of the shell, of the explosive carrier or cylinder centrally disposed within the bore or chamber of the body and held in non-contact with the inclosing chamber-wall by its supporting-rod that extends longitudinally beyond its ends and whereon it is adapted to move longitudinally, substantially as described.

11. The combination, with the body of the shell, of an explosive carrier or cylinder disposed within the bore or chamber of the body

upon a supporting-rod adaptable to longitudinal movement, and said explosive-carrier adapted to parallel and independent movement thereon, substantially as described.

12. The combination, with the body of the shell, of the cylindrical explosive-carrier mounted centrally within the bore or chamber of the body upon a center support extending longitudinally through the carrier to the ends of the chamber, the said carrier being in non-contact with the surrounding chamber-wall and retained yieldingly movable longitudinally by suitable cushioning interposed between its heads and the ends of the chamber of the body, substantially as described.

13. In a shell for high explosives, the combination of the breech-piece inclosing and engaging by its annular interiorly-threaded extremity the annular exteriorly-threaded end of the breech portion of the shell's body with the circumferential soft-metal flange or rim adjacent to the body's breech, and against which soft-metal portion the screwed breech-piece abuts, creating an air and gas tight union between said breech-piece and the breech portion of the shell's body, substantially as described.

14. The combination, with the body of the shell, of the explosive-carrier comprising an outer and an inner cylinder adapted to free and independent movement longitudinally, and mounted upon a centrally and longitudinally disposed guide and supporting rod within the chamber of the body, the outer peripheral surface of the interior cylinder lying in non-contact within the outer and inclosing cylinder, and the external cylinder lying in non-contact with the interior surface of the chamber of the body, substantially as described.

15. The combination, with the body of the shell, of a movable longitudinal guide or supporting rod therein, elastic cushions at the extremities of said rod, an explosive-carrier encircling said rod and comprising an inner and an outer cylinder, said cylinders being in non-contact with each other and said inner cylinder being in non-contact with said rod and said outer cylinder with the encircling inner surface of the body of the shell, elastic cushions for said inner cylinder interposed between the ends of the same and the outer cylinder, and coiled springs of varied diameter and thickness encircling said rod between the ends of said outer cylinder and the end walls of the shell and serving as elastic cushions for the explosive-carrier, substantially as described.

16. The combination, with the body of the shell, of the explosive-carrier centrally and longitudinally mounted upon a suitable support within the bore of said body and out of contact at all points with the encircling inner surface of the body, the said explosive-carrier being provided with one or more washers at its extremities, that snugly fit the central sup-

port of the carrier and whereby the center tube of the carrier surrounding said support is adapted to be held out of contact with aforesaid support, substantially as described.

17. The combination, with the body of the shell, of the explosive-carrier movably disposed upon a central and longitudinally-erected supporting-rod within the chamber of the body, the said carrier comprising an outer cylinder in non-contact with the surrounding chamber-wall and an inner explosive-charged cylinder in non-contact with the surrounding wall of the inclosing cylinder, the said interior cylinder being cushioned externally its extremities and the adjacent inner ends of the inclosing cylinder, substantially as described.

18. The combination, with the body of the shell, of the explosive-carrier centrally and longitudinally mounted upon the guide and supporting rod extending from end to end of the chamber of the body and cushioned thereat, and the mechanical cushioning disposed at or adjacent to the outer ends of the explosive-carrier and in proximity to the aforesaid guide and supporting rod, substantially as described.

19. The combination, with the body of the shell, of the centrally and longitudinally erected guide or supporting rod situated within the chamber of the body and lineally movable to a degree therein, provided at its front and rear portions with a series of coiled springs of varied diameter and stiffness, which encircle in non-contact one with the other the guide or supporting rod and adapted to movably retain in position the substantially-central interposed carrier, against which two or more of the springs indirectly abut, substantially as described.

20. The combination, with the body of the shell, of the attached annular soft-metal jacket provided at its rear end with an annular flange or rim, against which the contacting end of the breech-piece is adapted to forwardly press when secured to the body of the shell and forming an air and gas tight joint thereat, substantially as described.

21. A shell for high explosives, comprising a chambered body and an explosive-carrier therein consisting of separate independently-rotatable cylinders contained the one within the other, substantially as described.

22. A shell for high explosives, comprising a chambered rotatable body and an independently-rotatable explosive-carrier therein consisting of separate independently-rotatable cylinders contained the one within the other.

23. The combination, with the body of the shell and a longitudinal guide or supporting rod therein, of an explosive-carrier encircling said rod, said explosive-carrier being of less diameter than the bore or chamber of the body and cushioned solely at its ends.

24. The combination, with the body of the shell and a longitudinal guide or supporting rod therein, of an explosive-carrier loosely encircling said rod and of less diameter than the

bore or chamber of the body, whereby it will be out of contact both with the encircling inner wall of the bore or chamber and said rod and cushioned for said explosive-carrier located solely at the ends thereof.

25. The combination, with the body of the shell and a longitudinal guide or supporting rod therein, of an explosive-carrier comprising an inner and an outer cylinder, said inner cylinder having an opening through it for the passage of said rod of greater diameter than said rod, whereby it will be out of frictional contact with said rod, and said outer cylinder being of greater diameter than said inner cylinder and of less diameter than the

bore or chamber of the shell, whereby it will be out of frictional contact with the side wall of said inner cylinder and also with the wall of said bore or chamber, and elastic cushions for said cylinders located solely at the ends thereof.

In testimony whereof we affix our signatures, in presence of two witnesses, this 26th day of August, 1890.

EDWARD LEFEVER. [L. S.]
JOHN A. BREMNER. [L. S.]

Witnesses:

WM. C. RAYMOND,
LESTER A. WORDEN.