R. H. GODDARD.

ROCKET APPARATUS.

APPLICATION FILED DEC. 23, 1915.

1,194,496.

Patented Aug. 15, 1916.

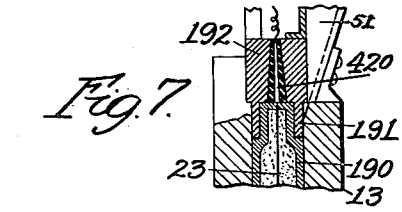

Fig. 7.

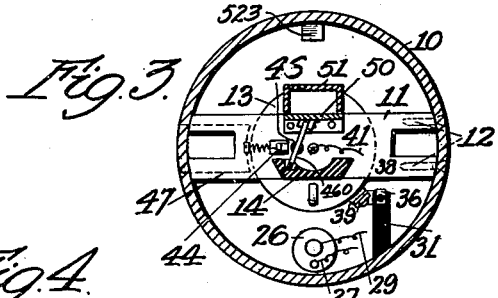

Fig. 3.

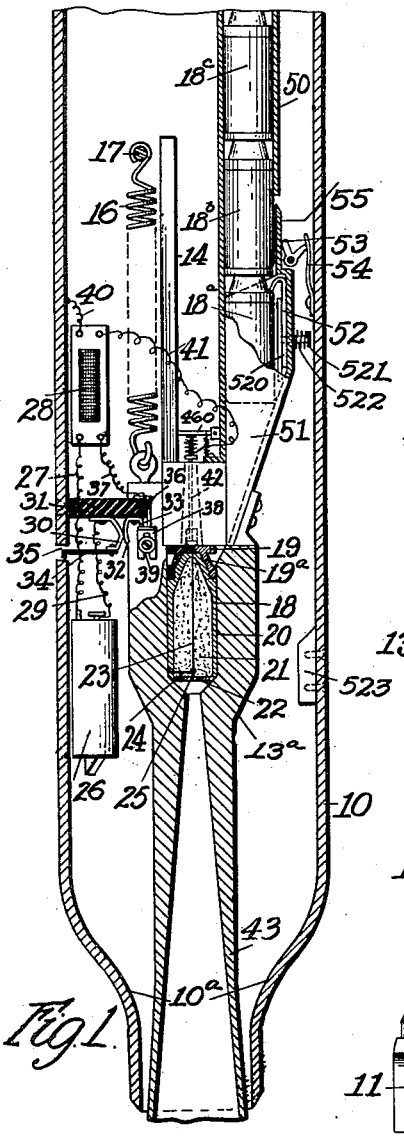

Fig. 1.

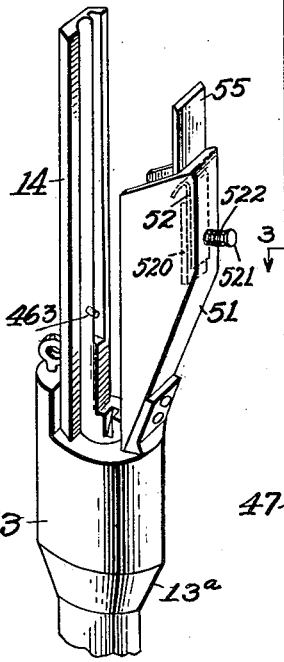

Fig. 4.

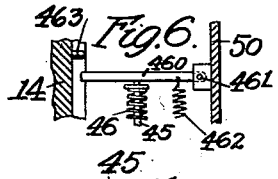

Fig. 6.

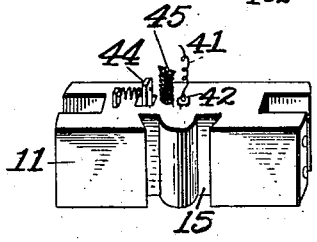

Fig. 5.

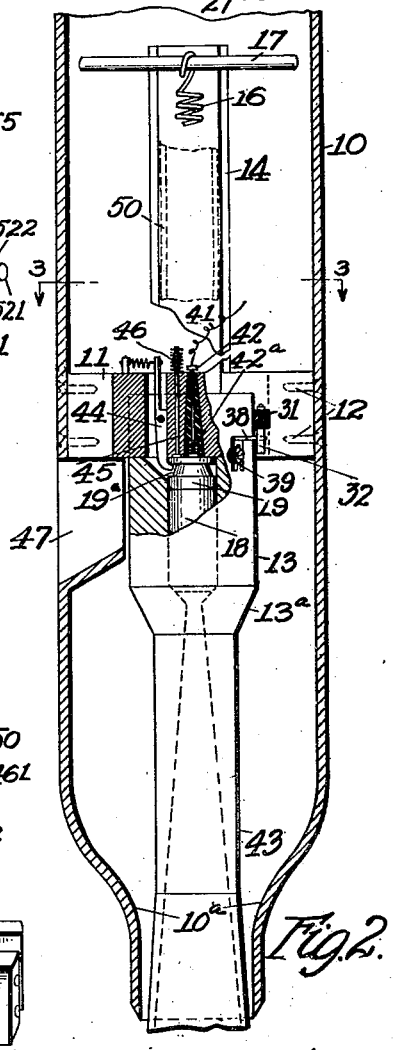

Fig. 2.

Witness
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UNITED STATES PATENT OFFICE.

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ROCKET APPARATUS.

1,194,496. Specification of Letters Patent. Patented Aug. 15, 1916.

Application filed December 23, 1915. Serial No. 68,437.

To all whom it may concern:

Be it known that I, ROBERT H. GODDARD, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Rocket Apparatus, of which the following is a specification.

This invention relates to rocket apparatus of the magazine type in which separate charges of explosive material are successively introduced into a comparatively small combustion chamber in which each is exploded to propel the apparatus through the air. Devices of this character are shown in my prior Patent No. 1,103,503, granted to me July 14, 1914, and also in my copending application Serial No. 60,240, filed November 8, 1915.

It is the object of my present invention to improve the construction of the devices therein shown and described, such improvements resulting in a material reduction of weight and in an extremely simple method of operation. The combustion chamber is closed by a breech block and one or both of these elements must be movable to provide the necessary momentum of a moving part for reloading the combustion chamber. In my prior patent both the chamber and the breech block are movable, first in unison and thereafter separately. This arrangement, while operative, necessitates the use of very complicated mechanism for reloading the combustion chamber.

In my copending application the chamber is fixed and the breech block only is movable. This arrangement permits me to simplify the reloading mechanism, but necessitates the use of two heavy members, the chamber being necessarily of substantial construction to withstand the force of the explosion and the breech block also being necessarily heavy to provide the requisite inertia and momentum.

In my present invention I have reduced the combined weight of the chamber and breech block and have avoided the complications of the first-described form by using a fixed breech block and a movable combustion chamber. The combustion chamber is of substantially the same weight as that employed in my copending application and the breech block, being fixed, is of comparatively light weight. This combination of a light fixed breech block and a movable combustion chamber in a magazine rocket apparatus constitutes an important feature of my invention.

Another feature of my invention relates to the provision of an improved form of cartridge for use in such apparatus.

Further features of my invention relate to certain arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of my invention is shown in the drawings in which—

Figure 1 is a vertical sectional elevation of my improved apparatus; Fig. 2 is a vertical sectional elevation taken in a plane normal to the plane of Fig. 1; Fig. 3 is a transverse sectional view taken along the line 3—3 in Fig. 2; Fig. 4 is a perspective view of the combustion chamber; Fig. 5 is a perspective view of the breech block; Fig. 6 is a detail view of the ejecting device; and Fig. 7 is a detail view of a modification.

Referring to the drawings, the rocket apparatus is inclosed within a casing 10 formed of comparatively thin sheet material, of correspondingly light weight. A breech block 11 (Fig. 5) is rigidly mounted within the casing 10 and may be secured in place in any convenient manner as by a plurality of screws 12, (Fig. 2).

A combustion chamber 13 is mounted below the breech block 11 and is movable relatively thereto. The combustion chamber is provided with an extended guide bar 14 (Fig. 4) which is adapted to slide in guideways 15 (Fig. 5) formed in the side of the breech block 11. A tension spring 16 (Fig. 1) is secured at its lower end to the combustion chamber 13 and at its upper end to a rod 17 fixed in the casing 10 and extending transversely therethrough. The spring 16 normally maintains the chamber 13 in contact with the breech block 11 and acts to restore the chamber to this position after the successive discharges of explosive material in the combustion chamber.

The explosive material is introduced into the chamber 13 in the form of a special cartridge 18. The cartridge 18 is provided with a metallic cap 19 having an annular notch or groove 19^a formed therein. The cap 19 is fitted snugly upon the end of a cylindrical casing 20 which is preferably formed of solid smokeless powder, the casing being

filled with explosive material 21 of any suitable form and being closed at its lower end with a patch 22 of cardboard or other suitable material. By forming the cartridge in this manner it will be seen that substantially the entire mass of the cartridge is available for propelling the apparatus, the light metal cap 19 alone remaining in the chamber after the explosion of the charge. In order to prevent accidental ignition of the cartridge by friction during the loading operation, and also to insulate the cartridge to a certain extent from the heated walls of the chamber, I provide the cartridge with a thin coating of some hard comparatively non-inflammable material such as shellac.

For firing the cartridge after it is positioned within the combustion chamber I provide special devices which will now be described.

Two small copper wires are secured within each cartridge, one of which wires 23 extends upwardly through the charge and through an opening in the metallic cap 19, the wire being suitably insulated from the cap and having its upper end exposed to form a contact member. The second wire 24 extends laterally through the charge near the lower end thereof and through the cylindrical wall of the cartridge, the outer end engaging and forming an electrical contact with the chamber 13. The other ends of the wires 23 and 24 are joined together by a small bead 25 of suitable explosive material such as fulminate of mercury.

A battery 26 is mounted within the casing 10 and one terminal of the battery is connected by a wire 27 to the primary of a spark coil 28. The other terminal of the battery is connected by a wire 29 to a contact piece 30 mounted upon a bracket 31 formed of insulating material and secured to the casing 10. The contact piece 30 normally engages a second contact piece 32, also mounted upon the bracket 31 and formed with a second terminal 33 at its other end.

Before the apparatus is loaded the contacts 30 and 32 may be separated by the use of a link 34 formed of insulating material and extending into a hole 35 in the casing 10. The link 34 may be engaged and drawn outward through the hole 35 and the hooked end of the link may be caused to engage the wall of the casing to hold the contacts apart until the link is manually released.

As above stated, the contact member 32 is provided with a second terminal 33 which is positioned adjacent to a terminal 36 also mounted upon the bracket 31 and connected by a wire 37 to the primary of the spark coil 28. A circuit-closing resilient contact member 38 (Fig. 2) is mounted on the combustion chamber 13 but is insulated therefrom by washers 39. When the circuit-closer 38 engages the terminals 33 and 36 the primary circuit will be closed, provided the link 34 has been released, and current will flow from the battery 26 through the wire 27, the primary of the spark coil 28, the wire 37, the terminal 36, the contact member 38, the terminal 33, the contacts 32 and 30 and the wire 29 back to the battery 26.

One terminal of the secondary of the spark coil 28 is connected by a wire 40 to the casing 10 and thus through the chamber 13 and the wire 24 to the explosive bead 25. The other terminal of the secondary is connected by a wire 41 to a contact member 42 mounted to slide in the breech block and suitably insulated therefrom. The member 42 is forced yieldingly downward by a light spring 42a. As shown in Fig. 1, the insulating material surrounding the contact member 42 is preferably tapered upwardly to resist the force of the explosion against its lower end. The contact member 42 engages the upper end of the wire 23 in the cartridge 18 as the chamber 13 closely approaches the breech block and the circuit is thus completed through the bead 25. Upon the closing of the primary circuit, the induced current in the secondary will explode the bead 25 and ignite the cartridge.

As the combustion chamber moves downward the primary circuit is broken and remains open until the chamber again approaches its position in contact with the breech block. The spring contact 38 may be arranged to close the circuit slightly before the chamber 13 engages the breech block, thus firing the charge while the chamber is still moving upwardly. This time interval of advance in firing may be so fixed that the resultant gas pressure in the chamber will bring the chamber to rest as it engages the breech block, the velocity of the chamber being substantially zero at the moment of engagement and the rebound of the chamber being thus eliminated.

The gases and other products of combustion are discharged through a tapering nozzle 43, the utility of which is fully described in my prior Patent No. 1,102,653, granted July 7, 1914. The upward pressure of the gases in this tapered nozzle offsets to a certain extent the downward pressure upon the chamber 13, and thus permits the use of a lighter spring 16 for controlling the movement of the combustion chamber than would be necessary if the nozzle were not used.

I will now describe the devices for ejecting the metallic cap after the charge has been exploded.

An extractor lever 44 (Fig. 2) is pivotally mounted in the breech block 11 and the projecting lower end of the lever is positioned within the groove 19a formed in the cap 19. An ejector rod 45 is slidably mounted in the

breech block and is maintained in raised position by a light spring 46 encircling the rod.

The ejector rod is engaged by a lever 460 mounted upon a fixed pivot 461 and held in contact with the rod 45 by a very light spring 462. The end of the lever 460 extends into the path of a stud 463 carried by the extension 14 of the chamber 13. As the stud moves down with the chamber after each explosion, it acts through the lever 460 to depress the rod 45 and swing the cap about the end of the extractor lever 44 as a pivot, ejecting the cap through an opening 47 (Figs. 2 and 3) formed in the side of the casing 10. In its continued downward movement, the stud 463 slips past the end of the lever 460, which is immediately returned to its normal position by the spring 46, this spring being substantially stronger than the spring 462. The downward travel of the chamber 13 is limited by the engagement of the tapered portion 13^a thereof with a contracted portion 10^c at the lower end of the casing 10. In its return movement, the stud 463 passes idly by the lever 460, lifting it from the ejector rod until the stud slips past the end of the lever.

A supply of fresh cartridges 18^a, 18^b, 18^c, etc., is contained within a two-part magazine, the fixed upper portion 50 of the magazine being rigidly mounted in the casing 10 and the movable lower portion 51 (Fig. 4) being mounted on the combustion chamber 13. The lower cartridge 18^a is positioned within the portion 51 of the magazine and moves downward with the chamber 13 after the explosion of the charge 18. In order to insure simultaneous movement of the cartridge and the chamber, the cartridge is engaged by a hooked spring 52 extending into the annular groove formed in the metallic cap thereof.

A plate 520 is positioned adjacent the cartridge 18^a, between the cartridge and the spring 52. The plate is supported upon a stud 521 extending through the spring 52 and the tube 51. A spring 522 encircles the stud and normally holds the plate against the flat spring 52. As the tube 51 moves downward with the chamber 13, the stud 521 engages a cam 523 fixed to the casing 10. This engagement occurs just as the upper end of the cartridge 18^a reaches a position below the lower edge of the breech block 11. The cam forces the stud 521 and plate 520 suddenly inward, moving the cartridge into position beneath the breech block.

As the chamber and tube move upwardly the cartridge is accurately seated in the combustion chamber. The wire 23 in the cartridge engages the contact member 42 and the extractor lever positions itself within the annular groove 19^a of the new cartridge. The cartridge is then ready for firing when the circuit is closed by the spring contact member 38.

In order to hold the cartridges 18^b, 18^c, etc., within the tube 50 during the reloading operation, I provide a retaining lever 53 (Fig. 1) pivoted in the casing 10, and actuated to engage the cartridges by means of a spring 54. A shield 55 (Figs. 1 and 4) formed at the upper end of the magazine tube 51 normally prevents engagement of the retaining lever with the cartridges in the tube 50, thus permitting a fresh cartridge to pass downward into the tube 51 after each reloading operation. As soon, however, as the chamber 13 and the tube 51 commence their downward movement the shield 55 is withdrawn and the lever 53 engages the cartridge 18^b and prevents downward movement thereof until the return of the tube 51.

The operation of the apparatus is thought to be clear from the detailed description previously given.

A supply of cartridges is placed within the magazine tubes and the first cartridge may be inserted in the combustion chamber by manually withdrawing the chamber and thus moving the tube 51 and the parts associated therewith to perform the loading operation. Previous to such movement the link 34 should be drawn outwardly and the end thereof should be engaged with the casing 10 to prevent premature firing of the apparatus. After the device is thus loaded the initial charge may be exploded by releasing the link 34 in any convenient manner. The rocket being thus started in flight, its flight will continue until the supply of cartridges in the magazine tubes is entirely exhausted.

The head of the rocket may be provided with heavy charges of explosive or with apparatus of any desired nature, as fully described in my prior patents and applications.

In the modification shown in Fig. 7, the entire cartridge, casing 190 is formed of smokeless powder, with the exception of the patch at the lower end, and the upper end of the cartridge fits closely within a sleeve 191 depending from the breech block 192. With this construction I am able to omit the extractor and ejector mechanism entirely and I require no opening 47 in the casing. Substantially the entire weight of each cartridge is also available for the propulsion of the apparatus.

It is not necessary in every case that the contact member 42 should be movably mounted. In Fig. 7 I have shown a fixed member 420 which member and its insulating sleeve are both of conical shape to resist the upward pressure of the exploded charge.

Having thus described my invention it will be evident that changes and modifica-

tions can be made therein by those skilled in the art without departing from the spirit and scope thereof as set forth in the claims and I do not wish to be otherwise limited to the details herein disclosed, but

What I do claim is:—

1. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing and devices actuated by said chamber effective to eject a spent cartridge from the casing and to thereafter insert a fresh cartridge in place thereof.

2. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber and nozzle mounted for longitudinal movement in said casing, a spring to restore said chamber to normal engagement with said breech block, and devices actuated by said chamber effective to eject a spent cartridge from the casing and to thereafter insert a fresh cartridge in place thereof.

3. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing, an extractor and an ejector supported by said breech block, and a member movable with said chamber effective to actuate said ejector to eject the spent cartridge from the casing.

4. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing, a magazine containing fresh cartridges, and means to eject a spent cartridge from said chamber and to insert a fresh cartridge therein, said magazine comprising a member fixed to said casing and a second member movable with said chamber relative to said casing.

5. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing, a magazine for fresh cartridges comprising a member fixed to said casing and a second member movable with said chamber relatively to the casing, a device mounted on said casing for retaining certain cartridges in the fixed member of said magazine while the movable member of the magazine is lowered, and a member supported by said chamber effective to release said retaining device as the chamber returns to normal position.

6. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing, a magazine for fresh cartridges comprising a member fixed to said casing and a second member movable with said chamber relatively to the casing, and means for pushing a cartridge laterally from said magazine and beneath said breech block when the cartridge reaches a predetermined longitudinal position in said casing.

7. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing, a magazine for fresh cartridges comprising a member fixed to said casing and a second member movable with said chamber relatively to the casing, and means for pushing a cartridge laterally from said magazine and beneath said breech block when the cartridge reaches a predetermined longitudinal position in said casing, said means comprising a plate in said movable magazine member, a stud supporting said plate, and a cam fixed in said casing and positioned to engage said stud as the combustion chamber and magazine member approach their lower limits of travel.

8. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing and devices for firing a cartridge in said chamber when the chamber returns to a predetermined position relatively to said breech block.

9. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for longitudinal movement in said casing, and a firing device which becomes effective as the chamber approaches normal position relatively to said breech block and slightly before said chamber contacts therewith.

10. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a movable combustion chamber and a cartridge fitting said chamber, said breech block having a depending sleeve attached thereto, and adapted to receive and inclose the upper end of said cartridge.

In testimony whereof I have hereunto set my hand.

ROBERT H. GODDARD.