R. H. GODDARD.

ROCKET APPARATUS.

APPLICATION FILED NOV. 8, 1915.

1,191,299. Patented July 18, 1916.

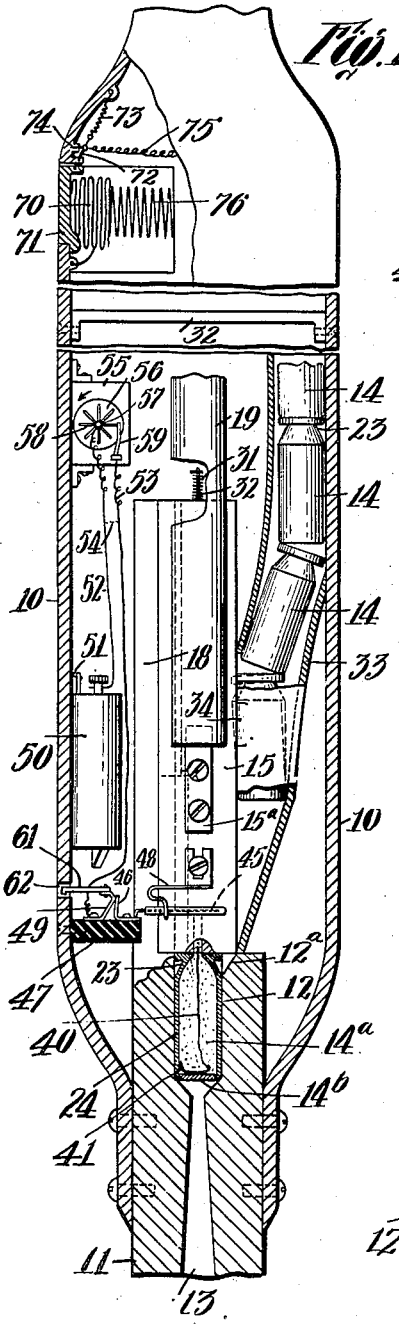

Fig. 1.

Fig. 6.

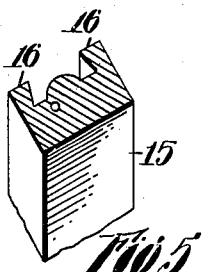

Fig. 5.

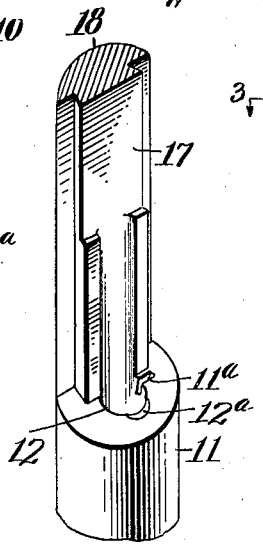

Fig. 4.

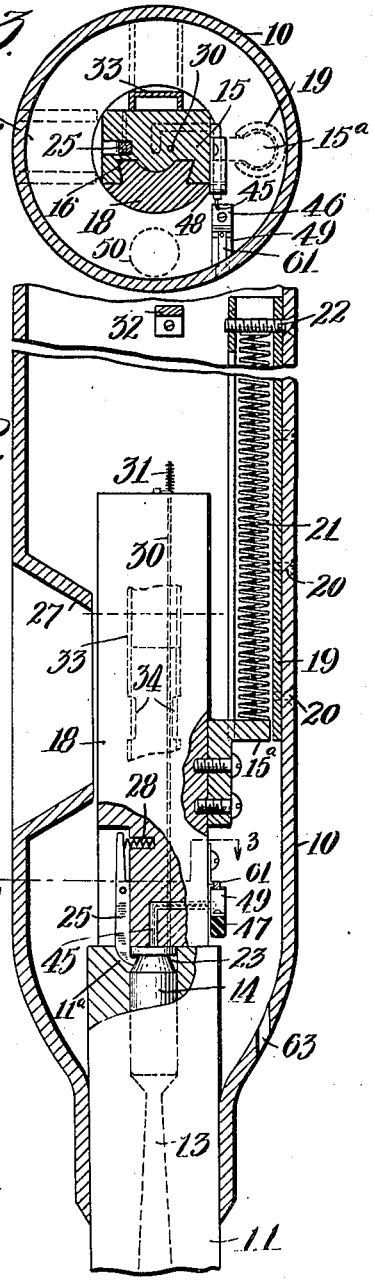

Fig. 2.

Fig. 3.

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ROCKET APPARATUS.

1,191,299. Specification of Letters Patent. Patented July 18, 1916.

Application filed November 8, 1915. Serial No. 60,240.

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 a rocket apparatus of the type in which small portions of the explosive charge are fired successively within a combustion chamber of small capacity but of great strength relative to the remaining structure. Such an apparatus is shown in my prior Patent No. 1,103,503 granted to me July 14, 1914.

It is the object of my present invention to improve and simplify the construction therein shown, said improvements resulting in increased economy of manufacture and in increased certainty and efficiency of operation.

With this general object in view one feature of my invention relates to the construction of a rocket apparatus of the type defined, in which the breech block is mounted for movement within the casing and in which the block in its travel extracts the empty shell from the fixed combustion chamber and inserts a fresh shell therein, this operation being repeated until the supply of cartridges in the casing is exhausted.

A second feature of my invention relates to the provision of means for firing each fresh charge after the breech block is seated, and in particular, to means for firing charges at predetermined time intervals, this latter provision being of prime necessity when accurate flights are required.

Another feature of my invention relates to the provision of a special type of cartridge and explosive by which the efficiency of the apparatus is much increased.

My invention also relates 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 the invention is shown in the drawings in which—

Figure 1 is a longitudinal sectional view of my improved rocket apparatus; Fig. 2 is a partial longitudinal sectional view taken in a plane normal to the plane of Fig. 1; Fig. 3 is a transverse sectional plan view taken along the line 3—3 in Fig. 2; Fig. 4 is a view in perspective of a portion of the member which contains the combustion chamber; Fig. 5 is a fragmentary detail view of a portion of the breech block, and Fig. 6 shows in section a modified form of cartridge.

Referring to the drawings, my improved rocket apparatus comprises a casing 10 of comparatively light-weight material and a member 11 fixed to said casing at its lower end. The member 11 is of great strength when considered in relation to the casing 10, and may preferably be formed of nickel steel. In its upper end the member 11 is bored out to provide a comparatively small combustion chamber 12 opening at its lower end directly into an outwardly tapering nozzle 13. The purposes and advantages of this tapered nozzle are fully set forth in my prior Patent No. 1,102,653 granted to me July 7, 1914.

The combustion chamber is adapted to receive a cartridge 14 containing the explosive charge 14^a and also preferably closed at its lower end by a patch or wadding 14^b of pasteboard or other suitable material.

The chamber 12 is normally closed at its upper end by a movable breech block 15 provided with under-cut guide strips 16—16 (Fig. 5), adapted to engage a guide 17 (Fig. 4) formed upon one face of an upward extension 18 of the member 11. The breech block 15 is also provided with a laterally-extending arm 15^a (Figs. 2 and 3), the outer end of which extends into a slotted spring casing 19 fixed to the outer casing 10 in any convenient manner, as by screws 20. A coiled spring 21 is contained within the spring casing 19, the lower end of the spring engaging the arm 15^a and the upper end of the spring engaging a stop which may be in the form of a screw 22 extending through the spring casing.

I have found by careful experiments that a small charge of properly selected explosive, when fired in a combustion chamber connected with a rearwardly tapering nozzle, such as is herein shown, will act substantially instantaneously, the product of combustion being blown out from the tapering tube before the breech block can begin its upward travel. Such upward travel of the block is resisted in the present apparatus

by the spring 21 by which the block is gradually brought to rest, the weight of the block and the pressure of the spring thereafter restoring the block to the normal position in which it closes the combustion chamber. I utilize this reciprocation of the breech block to withdraw and eject the empty cartridge shell and to insert a fresh charge in the combustion chamber. An extractor lever 25 is pivoted in a slot formed in the breech block near its lower end, and the hooked end of the extractor extends below the breech block into position to engage an annular shouldered groove or recess 23 formed in the shell 24 of the cartridge 14. The member 11 is recessed at 11ª (Fig. 4) to receive the end of the extractor. As the breech block rises the empty shell is constrained to follow the movement of the block until the shell reaches a position opposite an inwardly flanged open portion 27 of the casing 10. A spring 28 engages the upper end of the extractor lever and holds it in operative position.

An ejector rod 30 extends longitudinally through the breech block and at its lower end engages the head of the shell 24 near one edge thereof. At its upper end the rod 30 extends beyond the breech block and is normally held in raised position by a light coiled spring 31. As the breech block approaches its upper limit of travel, the rod 30 engages a lug 32 fixed to the casing 10 and is forced downwardly relative to the breech block, thereby thrusting the empty shell out of the casing through the opening 27.

The fresh cartridges 14 are stored within a magazine tube 33 (Fig. 1), which tube is preferably square in cross section and is open at its lower inner end adjacent the breech block 15. The cartridges may be yieldingly forced downward by follower mechanism such as is described in my prior Patent No. 1,103,503. The lowermost cartridge rests against the side of the breech block and as the block reaches its extreme upper position the cartridge moves slightly inward to the position shown in dotted lines in Fig. 1. Further inward movement of the cartridges is prevented by ears 34 (Figs. 1 and 2), formed by bending inward small portions of the opposite edges of the magazine tube 33. These flanges prevent the fresh cartridge from moving inward a sufficient distance to be engaged by the empty shell or by the ejector rod, but at the same time retain the fresh cartridge in position for engagement by the adjacent edge of the breech block in its downward movement. The block carries the cartridge downward into the combustion chamber 12, the upper edge of which is beveled as at 12ª, in order to guide the cartridge into the chamber.

The cartridges 14 are filled with a dense smokeless powder and I have shown herein two different devices for firing the charge. In the cartridge which is positioned in the combustion chamber 12 I have shown a wire 40 having its upper end secured by suitable insulation in the head of the cartridge, the lower end of the wire being connected to a fine resistance wire 41 extending nearly across the lower end of the cartridge and having its outer end secured to the shell 24. When a suitable electrical current is passed through the wires 40 and 41, the wire 41 becomes heated and simultaneously ignites the entire lower end of the charge, a manner of igniting which I have found to be absolutely essential when using a comparatively slow-burning powder.

The second form of ignition is shown in Fig. 6, in which form the wire 42 is supported in the same way as the wire 40 previously described and a second wire 43 is secured to the lower end of the shell 24 and extends to the center of the lower face of the charge. At this point the ends of the wires 42 and 43 are joined by a small bead 44 of fulminating material, such as fulminate of mercury. A spark coil (not shown) will be used with this form of firing device in addition to the battery 50, to be described.

I will now describe a form of circuit through which electric current may be supplied to the firing devices.

An insulated wire 45 (Figs. 1, 2 and 3) is mounted in the lower end of the breech block and has one end positioned for engagement with the upper end of the wire 40, secured in the end of the cartridge 14. The other end of the wire 45 engages a contact member 46 mounted upon a block 47 of insulating material secured to the casing 10. A spring 48 (Fig. 1) is secured to the breech block near its lower end and holds the outer end of the wire 45 firmly against the contact member 46. A second contact member 49 is also mounted on the block 47 and normally engages the member 46. A battery 50 of ordinary type is mounted within the casing 10 and one pole of the battery is directly connected, as by a wire 51, to the casing 10. The opposite pole of the battery may be connected to the contact member 49 by wires 52 and 53. The wires 52 and 53 may be directly connected, as indicated by the dotted line 54 in Fig. 1, or they may be intermittently connected to each other by a timing device, 55. This device may be of any usual construction and is herein shown as comprising a disk 56 mounted upon an arbor 57 and provided with a plurality of radiating arms 58 each electrically connected with the arbor 57. The wire 52 is connected to the arbor 57 and is thus in circuit with each of the arms 58 and the wire 53 is connected to a spring arm 59 adapted to

contact successively with the arms 58 as the disk 56 is rotated by clockwork (not shown).

If the wires are directly connected to each other, the charge will be fired as soon as the breech block has seated itself upon the combustion chamber whereas if the timing device is included within the circuit the cartridges will be fired at predetermined time intervals, each of which intervals should be slightly greater than the time required by the breech block for completing its movement.

The timing device is particularly useful when it is desired to secure the greatest possible efficiency from the apparatus and also when successive flights of identical character are required, as will be the case if the apparatus would be used in warfare against a fixed object of attack. The spring 48 may be utilized to slightly prolong the contact when no timing device is used.

For firing the first cartridge, the contact member 49 is provided with a link 61 of insulating material extending outwardly through an opening 62 in the side of the casing 10, the link being turned downward at its outer end to provide a hook for engagement with the side of the casing. The contact members 46 and 49 may thus be separated, preventing the firing of the apparatus until the link 61 is released.

The magazine tube may be conveniently loaded in the manner described in my prior Patent No. 1,103,503, and the initial charge may be placed within the combustion chamber by manually inserting a small rod through an opening 63 (Fig. 2) near the lower end of the casing 10. This rod will engage the projecting arm 15^a carried by the breech block and the block may be thereby raised sufficiently to release the lowermost cartridge which will then be carried down by the breech block into the combustion chamber, as previously described.

It will thus appear that I have devised an extremely simple and reliable apparatus by which a series of small charges of explosive material may be successively fired within a combustion chamber of great strength. By using the explosive in successive small charges, I can use smokeless powder of high power and great efficiency, which has not been previously considered possible in rocket apparatus. I am also able to use a patch or wadding in the cartridge, and I have found that the use of high explosive in combination with the patch or wadding increases the effectiveness of the device not less than twenty-two fold as compared with the ordinary rocket or Coston signal.

The device is adapted for carrying large charges of explosive as described in my Patent No. 1,103,503, and is also adapted for carrying photographic and recording apparatus of different types. When used for the latter purpose I provide the parachute arrangement shown in Fig. 1, in order that the apparatus may be safely landed.

The folded parachute is indicated at 70 and is retained within the casing 10 by a door 71 secured in position by a pin 72. A spring 73 is connected to the pin for withdrawing the same, and the withdrawal of the spring is prevented by a cross pin 74 of highly combustible material, such as dense smokeless powder or celluloid. This pin is connected to the firing apparatus by a wire 75. When current is passed through the wire the pin 74 will be ignited thus releasing the pin 72 which will then be withdrawn by the spring 73. The door 71 and the folded parachute 70 are then forced out of the casing by a spring 76.

Having thus described my invention it will be evident that changes and modifications 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 claim is:—

1. A rocket apparatus having, in combination, a casing, a member of great strength fixed in said casing and having a comparatively small combustion chamber therein, a movable breech block for closing said chamber, a guide for said block, and means to yieldingly resist movement of said block away from said chamber.

2. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber therein, a sliding breech block mounted on guides fixed in said casing, and a spring effective to seat said breech block on said combustion chamber.

3. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber therein, and a sliding breech block normally seated on said chamber, said member having an upward extension beyond said chamber effective to guide said breech block in its travel relatively to said chamber.

4. A rocket apparatus having, in combination, a casing, a member of great strength fixed in said casing and having a comparatively small combustion chamber therein, a movable breech block for closing said chamber, a guide for said block, and means to restore said block to normal position relatively to said chamber.

5. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber therein, a movable breech block for closing said chamber, a guide for said block, and means to restore said block to normal position relatively to said cham-

ber, said breech block having mounted thereon an extractor to remove the empty shell from the combustion chamber, and an ejector to force the shell outwardly through an opening in said casing.

6. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber therein, a movable breech block for closing said chamber, a guide for said block, and means to restore said block to normal position relatively to said chamber, said breech block having mounted thereon an extractor to remove the empty shell from the combustion chamber and an ejector rod slidable longitudinally in said breech block, said rod being adapted to engage a stop fixed in said casing as the breech block approaches its upper limit of travel and being thereby rendered effective to remove said shell from said extractor.

7. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber therein, a movable breech block for closing said chamber, a guide for said block, and means to restore said block to normal position relatively to said chamber, said breech block being provided with devices mounted thereon effective to remove and eject an empty shell as the block rises and said block being effective to insert a fresh shell as the block returns to normal position.

8. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber and means for successively firing said cartridges.

9. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber, and means for successively firing said cartridges at predetermined time intervals.

10. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber, and means for successively firing said cartridges, said latter means comprising an electric circuit and a time-controlled circuit-closing device in said circuit.

11. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber, and means for successively firing said cartridges, each of said cartridges comprising a shell closed at its lower end by a patch of suitable material and having an electric contact mounted in its opposite end.

12. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber, and means for successively firing said cartridges, each of said cartridges being adapted to be connected into an electric circuit when positioned in said combustion chamber and having a resistance wire in engagement with the combustible charge for firing the same.

13. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber, and means for successively firing said cartridges at predetermined time intervals, said means comprising a battery in said casing and electric connections from said battery to the cartridge in said combustion chamber.

14. A rocket apparatus having, in combination, a casing, a member fixed in said casing and having a comparatively small combustion chamber formed therein, a plurality of cartridges retained within said casing, means to feed said cartridges singly to the combustion chamber, and means for successively firing said cartridges, each of said cartridges comprising a shell closed by a patch at its lower end, a charge of high explosive, and devices within said shell adapted to be connected into an electric circuit for firing said charge electrically.

In testimony whereof I have hereunto set my hand.

ROBERT H. GODDARD.