R. H. GODDARD.

ROCKET APPARATUS.

APPLICATION FILED JUNE 28, 1916.

**1,206,837.**

Patented Dec. 5, 1916.

3 SHEETS—SHEET 1.

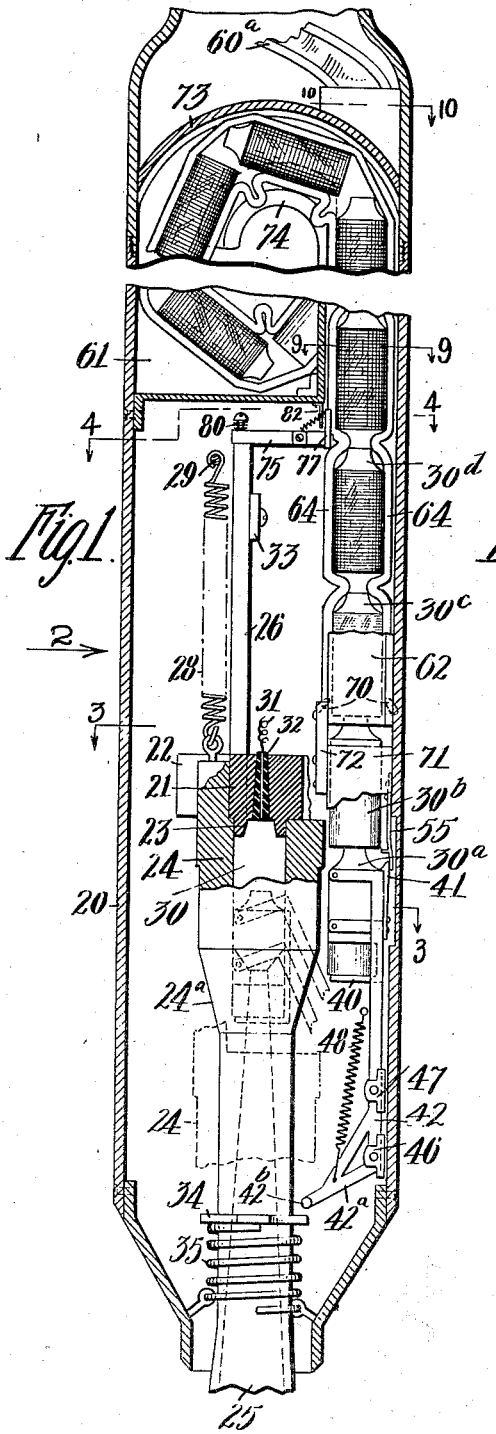

Fig. 1.

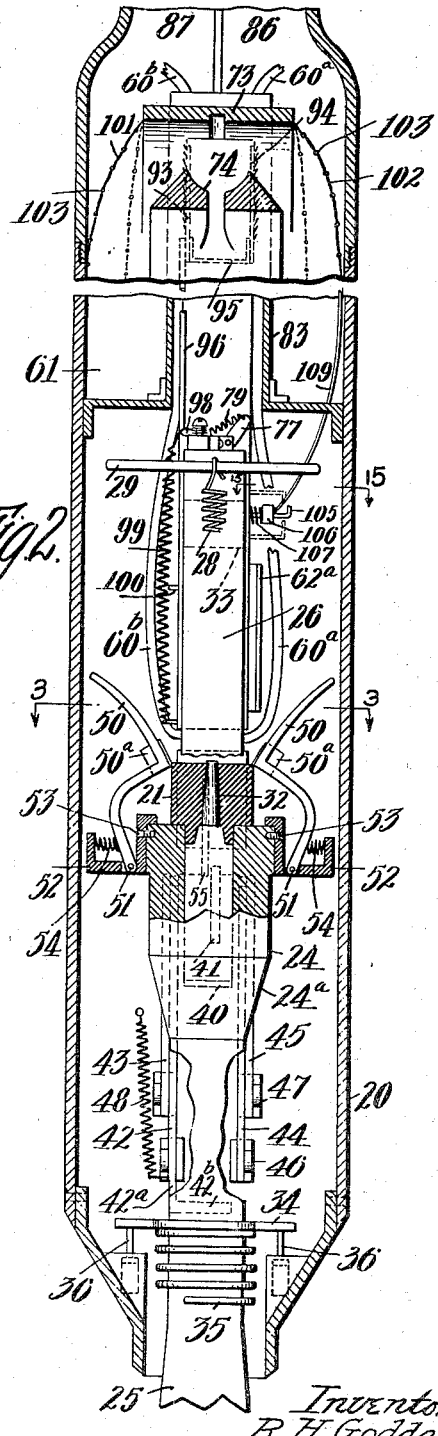

Fig. 2.

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3 SHEETS—SHEET 2.

Fig. 3.

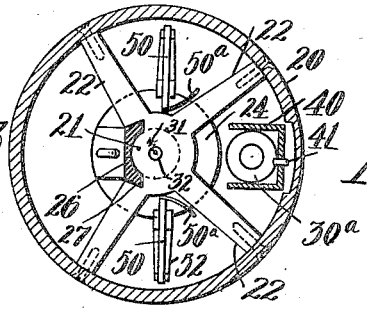



Fig. 4.

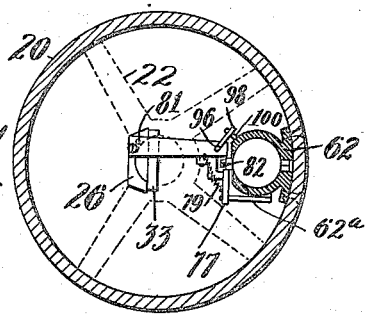



Fig. 7.

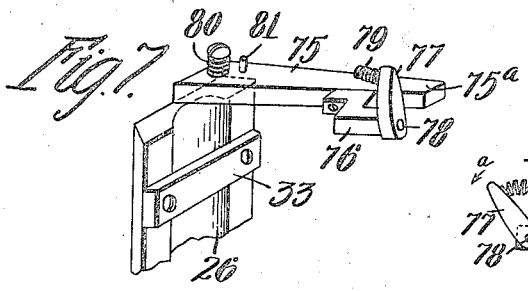



Fig. 8.

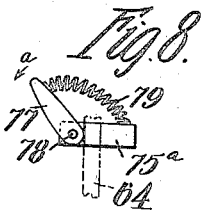



Fig. 6.

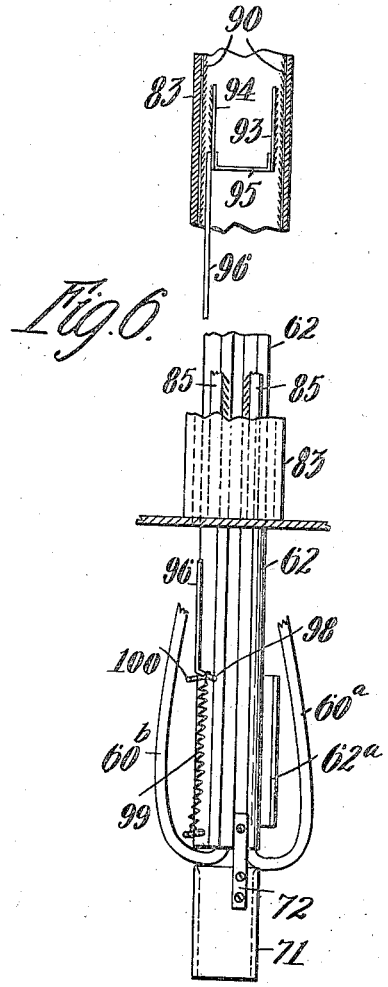
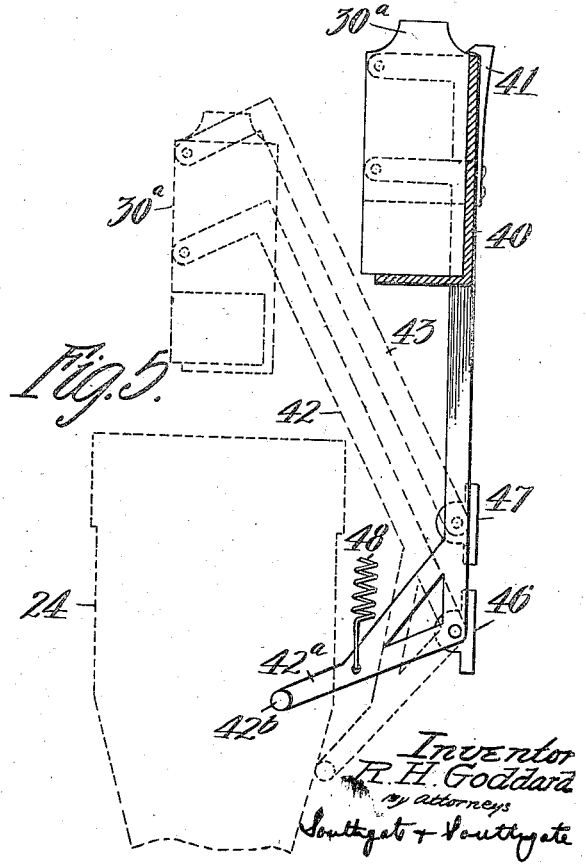



Fig. 5.

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3 SHEETS—SHEET 3.

Fig. 9.

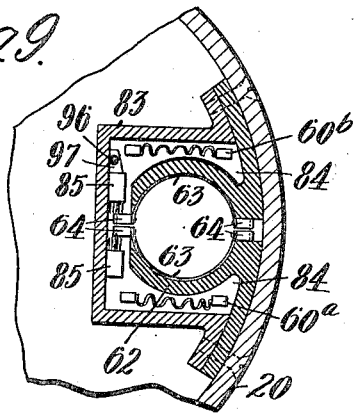
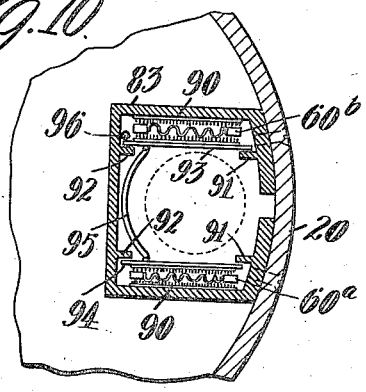



Fig. 10.



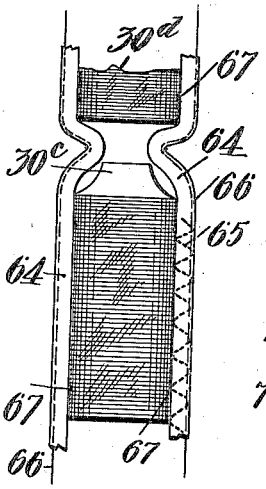




Fig. 12.

Fig. 13.

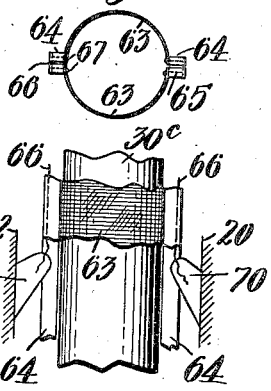



Fig. 14.

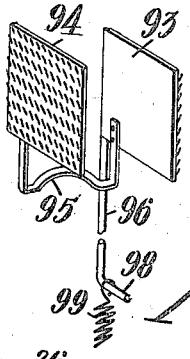



Fig. 11.

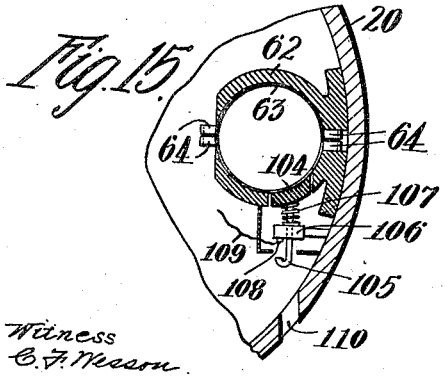



Fig. 15.

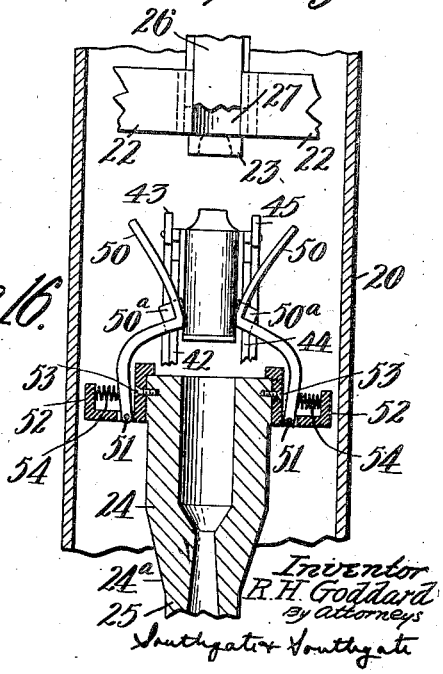



Fig. 16.

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# UNITED STATES PATENT OFFICE.

ROBERT H. GODDARD, OF WORCESTER, MASSACHUSETTS.

## ROCKET APPARATUS.

1,206,837. Specification of Letters Patent. Patented Dec. 5, 1916.

Application filed June 28, 1916. Serial No. 106,507.

*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 and particularly to a rocket apparatus of the magazine type. Different forms of such apparatus are shown in my prior Patents No. 1,103,503 issued July 14, 1914, No. 1,191,299 issued July 18, 1916, and No. 1,194,496 issued August 15, 1916.

It is the general object of my present invention to improve the construction of the devices therein shown to the end that the apparatus may be rendered more efficient and reliable in operation. With this general object in view my present invention is directed largely to improvements in the cartridge-replenishing mechanism. In the preferred form herein shown I provide a cartridge holder mounted for parallel movement and effective to position a fresh cartridge in a definite and exact loading position. I also provide retaining devices for holding the cartridge in loading position during the return of the holder to its normal position. I further provide a new and improved container for the supply of cartridges and I disclose herein novel devices for holding said cartridges in spaced relation, therein, and for releasing them as they successively approach the transfer position.

Another feature of my invention relates to the suitable disposal of the material forming the cartridge container after the cartridges are released therefrom.

My invention further 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 my invention is shown in the drawings in which—

Figure 1 is a sectional elevation of my improved rocket apparatus; Fig. 2 is a sectional elevation taken in the plane perpendicular to the plane of Fig. 1, and looking in the direction of the arrow 2 in said figure; Fig. 3 is a transverse sectional plan view, taken along the line 3—3 in Figs. 1 and 2; Fig. 4 is a similar view taken along the line 4—4 in Fig. 1; Fig. 5 is an enlarged detail view of the cartridge holder; Fig. 6 is a front elevation, partly in section, of the magazine tube; Fig. 7 is a perspective view of a device for feeding the cartridge container; Fig. 8 is an end elevation of certain of the parts shown in Fig. 7; Figs. 9 and 10 are detail transverse sections taken along the lines 9—9 and 10—10 in Fig. 1, respectively; Fig. 11 is a detail perspective view of the strip feeding device; Fig. 12 is an enlarged sectional view of a portion of the cartridge container; Fig. 13 is a transverse sectional view of the container; Fig. 14 is a detail elevation showing the knives for separating the two portions of the container; Fig. 15 is a detail transverse section taken on the line 15—15 of Fig. 2, and showing certain firing mechanism, and Fig. 16 is a partial sectional elevation corresponding to Fig. 2 but showing the parts in a different position.

Referring particularly to Figs. 1 and 2, my improved rocket apparatus comprises a casing 20 within which a breech block 21 is rigidly secured, the block being attached to the casing by means of outwardly projecting arms 22 (Fig. 3). On its underside the breech block may be provided with a depending annular projection 23 (Figs. 1 and 2) which extends into a recess in the combustion chamber 24. This chamber is substantially similar to that shown and described in my prior Patent No. 1,194,496, and comprises a depending tapering expansion nozzle 25 and an upward extension 26 (Figs. 1 and 3) which forms a guiding support for the chamber and is slidable in ways 27 formed in the breech block 21. The chamber is normally held in its upper position by a spring 28 connected at its lower end to the chamber 24, and at its upper end to a cross rod 29 fixed in the casing 20.

The combustion chamber 24 is designed to receive a cartridge 30 fitting therein, and any suitable arrangement for firing the cartridge may be provided. I have herein shown a wire 31 (Fig. 1) extending downward through a tapered insulating member 32 fixed in the breech block, said wire at its lower end making suitable electrical connection with firing devices contained in the cartridge. For a full description of this form of firing mechanism, reference is made to my prior Patent No. 1,194,496. Upon the

explosion of the cartridge 30 the combustion chamber 24 moves downward to the dotted line position indicated in Figs. 1 and 5. The lower limit of travel is fixed by a stop 33 on the extension 26 which engages the upper surface of the breech block 21. As the chamber 24 approaches its lowermost position, the tapered portion $24^a$ engages a plate 34 supported by a spring 35 secured to the lower end of the casing 20. The plate 34 may be provided with plungers 36—36 connected with the pistons of suitable dash pots of any usual construction. The spring 35 acting through the plate 34 resists the downward pressure of the combustion chamber, and brings it substantially to rest before the stop 33 engages the breech block, while at the same time the dash pot arrangement prevents a violent rebound of the combustion chamber.

Assuming that the cartridge has been exploded and that the chamber 24 has moved to its lowermost position, I will now describe the mechanism for placing a fresh cartridge in the combustion chamber. This cartridge $30^a$ is shown in full lines in the position which it occupies during the explosion of the cartridge 30. The cartridge $30^a$ is held in a cartridge-supporting device best shown in Figs. 1 and 5, and comprising a cartridge holder 40 having a portion extending beneath the cartridge and also having portions engaging the cartridge upon three sides thereof. A spring 41 snaps inward over the upper end of the cartridge when it is positioned in the holder, and prevents displacement of the cartridge during its movement to loading position.

The holder 40 is mounted upon two pairs of L-shaped links 42, 43, 44 and 45. These links are pivotally connected to brackets 46 and 47 fixed to the casing 20. The link 42 has an extension $42^a$ at its lower end, this extension having a portion $42^b$ extending sidewise therefrom in position to be engaged by the tapered portion $24^a$ of the combustion chamber, as the chamber approaches its lowermost position. When thus engaged the cartridge holder is moved from the position shown in full lines in Figs. 1 and 5 to the dotted line position therein. A spring 48 normally maintains the holder in the full line position. The support 40 as it moves to loading position is maintained parallel to the axis of the casing 20 by the links 42, 43, 44 and 45. The cartridge $30^a$ is thus moved positively to a definite and exact loading position.

As the combustion chamber returns to normal position, the cartridge holder also returns to its original position, and devices are necessarily provided for preventing the return of the cartridge with the holder thus removing the cartridge from loading position. These devices are best shown in Figs. 2, 3 and 16, and comprise a pair of arms 50 pivoted at 51 to brackets 52 mounted on the combustion chamber 24 and secured thereto by screws 53. When the chamber is in firing position the arms 50 are spread apart by the breech block 21. As the chamber descends to the position shown in Fig. 16, the arms clear the breech block and are forced inwardly by compression springs 54 to the position shown in Fig. 16. With the arms in this position, the cartridge $30^a$ is moved to loading position. The arms are provided with ears or projections $50^a$ which engage the cartridge $30^a$ as it approaches loading position, the arms 50 being forced apart thereby. The cartridge moves inward until it engages the grooved side of the extension 26 of the chamber 24, and as the holder is withdrawn the cartridge is retained in this position by the arms 50. As the holder is being withdrawn the combustion chamber is moving upward and the fresh cartridge is immediately seated therein, the upper end of the cartridge entering the annular projection 23 of the breech block 21.

A flat spring catch 55 (Fig. 1) is secured to the casing 20 above the holder 40, and is normally pushed back into a recess in the casing by engagement with the upper end of the spring 41. As soon, however, as the cartridge holder begins to move, the catch 55 is released and springs out under the cartridge $30^b$ next above, thus preventing this cartridge from moving downward until the holder returns to normal position. Engagement by the spring 41 then withdraws the catch 55.

I will now describe the mechanism for supplying successive cartridges to the cartridge holder 40. The cartridges in my improved apparatus are mounted in a flexible tubular container 60 which is coiled within a storage chamber 61 (Figs. 1 and 2), and which is withdrawn therefrom through a magazine tube 62 (Fig. 6). In the preferred form the container 60 is formed of two strips 63—63 (Fig. 13) of flexible material having their edges secured to narrow strips 64 of leather or other similar material. These strips 64 may be reinforced by wire stitching 65 if so desired, and the two portions of the container are assembled by stitching the strips 64 together in pairs to form ribs, the stitches being indicated by the numeral 66 (Fig. 12).

The strips 64 are inwardly creased at intervals, thereby spacing the successive cartridges $30^c$ and $30^d$ (Fig. 12) and also providing for the necessary expansion on one side or the other in rounding sharp curves as the cartridges are drawn from the chamber 61. For more accurately spacing the cartridges, studs 67 (Figs. 12 and 13) may be placed in the container in spaced relation and corresponding indentations may be made

in the cylindrical outer wall of the cartridges. These cartridges are preferably formed as described in my prior Patent No. 1,191,299 with a combustible casing so that the entire cartridge is consumed and there is nothing left to be ejected from the combustion chamber.

The magazine tube 62 is formed in two separate parts best shown in Fig. 15, these parts being each fixed to the casing 20, and providing spaces between them to accommodate the outwardly projecting strips or ribs 64 as the cartridge container is drawn downward by mechanism to be described. As the cartridges approach the lower end of the tube 62 the container engages knives 70—70 (Fig. 14) mounted in fixed position in the casing, and having their rounded ends extending between the strips 64 in position to sever the stitches 66. The container is thus separated into two portions or strips $60^a$ and $60^b$ (Fig. 6) and the cartridge is thus released from the tubular container.

A cylindrical sleeve 71 (Fig. 6) forms an extension of the magazine tube and is secured thereto by a rod 72. The sleeve and the tube are spaced apart sufficiently to permit the portions $60^a$ and $60^b$ of the severed container to pass between them, and the opening in the sleeve is flared outwardly at its upper end to guide the cartridges therein. The sleeve 71 retains the cartridge $30^b$ in position until the cartridge holder 40 is emptied and returns to normal position, when the cartridge $30^b$ is released and passes into the holder 40. As the cartridges in their container pass out of the chamber 61 they engage grooved guides 73 and 74 (Fig. 1) by which they are directed into the upper end of the magazine tube.

Suitable mechanism is provided for intermittently advancing the cartridges along the magazine tube 62. These devices are best shown in Figs. 7 and 8, and comprise an arm 75 extending laterally from the upper end of the extension 26 of the combustion chamber 24. At its outer end an offset bracket 76 is secured to the arm, and a gripping pawl 77 is pivoted to said bracket at 78. A coiled spring 79 normally forces the pawl in the direction of the arrow *a* in Fig. 8. One pair of strips 64 passes between the pawl 77 and the extension $75^a$ of the arm 75. As the arm 75 moves upwardly with the extension 26 and the chamber 24, the pawl slips freely past the strips 64, but upon the next descending movement of the arm 75, the pawl grips the strips 64 and carries the tubular container downward the necessary distance to advance another cartridge to the position indicated by $30^b$. This distance is determined by a plate $62^a$ (Fig. 6) which engages and releases the pawl 77. In order to prevent too sudden downward movement of the container, the arm 75 may be yieldingly secured to the upper end of the extension 26, as shown in Fig. 7, the arm rising slightly against the pressure of the spring 80 as the downward movement begins. A pin 81 fixed in the extension 26 and extending freely through the arm 75 prevents angular displacement thereof. A small plate 82 (Fig. 1) secured beneath the chamber 61 assists in guiding the strips 64 between the pawl 77 and the extension $75^a$ of the arm 75.

In its upper portion the tube 62 is surrounded by a substantially rectangular casing 83 (Fig. 9), said tube and casing being spaced apart to provide passages 84—84 for the severed strips $60^a$ and $60^b$. The casing 83 also supports narrow strips 85—85 of card clothing or similar material having points inclined downward, and engaging the strips 64. The tubular container is thus free to move downward, but backward movement thereof is prevented. The severed portions of the tubular container pass upward and out of the upper end of the casing 83 into a storage space which may comprise separate compartments 86 and 87 formed in the upper portion of the casing 20.

I will now describe the mechanism for feeding the severed portions or strips of the container into the compartments 86 and 87. The upper portion of the casing 83 (Fig. 10) is lined upon its opposite sides with strips 90 of card clothing, with the points inclined upwardly. Inwardly projecting lugs 91—91 and 92—92 form guides for a pair of thin metal plates 93 and 94 (Fig. 11) joined together by a curved connecting member 95, and having their outer faces covered with card clothing with the points also inclined upwardly and facing the strips 90. The plates 93 and 94 are vertically slidable within the casing 83, and are controlled by a rod 96 extending downward through the casing and guided near its lower end in a bearing 97 (Fig. 9). The lower end of the rod 96 is turned at a right angle at 98 and projects above the extension $75^a$ of the arm 75 (Fig. 7). A spring 99 (Fig. 6) connected at one end to the part 98 and at the other end to a pin on the magazine tube 62 normally draws the plates 93 and 94 downwardly whenever the combustion chamber 24 and the arm 75 descend, the downward movement of the plates being limited by a stop pin 100 (Fig. 6). During this downward movement the points of the card clothing slide freely past the severed portions of the container which are prevented from downward movement by the strips of card clothing 90. The stop pin 100 limits the downward movement to the exact distance from center to center of successive cartridges in the container 60. Upon the return movement of the combustion chamber the extension $75^a$ of the arm 75 engages the portion 98 of the rod 96 and carries the

plates 93 and 94 upwardly, thereby feeding the severed strips into the chambers 86 and 87. As successive cartridges are fired the storage chamber 61 is gradually emptied and the compartments 86 and 87 are gradually filled.

In order to utilize the storage space in the casing 20 to the fullest extent I separate the chamber 61 from the compartments 86 and 87 by flexible partitions 101—102 (Fig. 2), said partitions having elastic bands 103 embodied therein, which tend to move the partitions to the dotted line position in Fig. 2, as the cartridges are removed from the chamber 61. In this way the capacity of the compartments 86 and 87 is increased as the chamber 61 is gradually emptied of cartridges. After the supply of cartridges in the apparatus has been substantially exhausted and the rocket has substantially completed its flight, provision is made for operating any apparatus or discharging any explosives carried by the rocket. This mechanism is best shown in Fig. 15, and comprises a loose plate 104 forming a portion of one side wall of the magazine tube 62. The plate 104 is secured to a rod 105 slidable in a fixed bearing 106, and the plate is forced into the tube by a spring 107 whenever the supply of cartridges at that point becomes exhausted. When the plate thus moves in, the hook-shaped outer end of the rod 105 discharges a percussion cap 108 and ignites a fuse 109 which is connected with the mechanism or explosives carried in the rocket. An opening 110 in the casing 20 permits insertion of a hook to withdraw the plate 104 when the apparatus is being loaded.

The cartridge container 60, when it is inserted in the apparatus, is provided with a sufficient length of severed strips $60^a$ and $60^b$ at its lower end so that they may be threaded up through the casing 83 and pass the feeding plates 93 and 94. The first cartridge may be inserted within the combustion chamber by drawing the chamber downwardly by hand to actuate the cartridge holder 40.

Having thus fully described the construction of my improved rocket apparatus, it is thought that the operation thereof will be clearly understood. I have shown it embodied in an apparatus in which the combustion chamber only is movable but many features of my invention are also applicable to constructions in which the breech block moves or in which both breech block and chamber move.

It will be evident that changes and modifications can be made in my invention 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 of construction herein described, but

What I do claim is:—

1. A rocket apparatus having, in combination, a casing, a fixed breech block, a combustion chamber movably mounted in said casing, a cartridge supporting device actuated by downward movement of said chamber to present a cartridge in definite and exact loading position while the chamber and breech block are separated, and means independent of said moving member effective to hold said cartridge in loading position during the return movement of said chamber.

2. A rocket apparatus having, in combination, a casing, a fixed breech block, a combustion chamber movably mounted in said casing, a cartridge supporting device operable by downward movement of said chamber to present a cartridge in definite and exact loading position while the chamber and breech block are separated, means to return said device to normal position as the chamber rises, and means independent of said chamber to retain said cartridge in loading position as the supporting device is withdrawn.

3. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for movement in said casing, and a cartridge-replenishing mechanism comprising a supporting device mounted on said casing and having a portion positioned for engagement by said chamber as it descends, by which engagement the cartridge is moved to exact loading position.

4. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for movement in said casing, a cartridge-replenishing mechanism comprising a supporting device mounted on said casing and having a portion positioned for engagement by said chamber as it descends, by which engagement the cartridge is moved to loading position, and retaining devices yieldingly movable into position to hold said cartridge in loading position as the chamber re-approaches the breech block.

5. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for movement in said casing, a cartridge-replenishing mechanism comprising a supporting device mounted on said casing and having a portion positioned for engagement by said chamber as it descends, by which engagement the cartridge is moved to loading position, and retaining devices normally rendered inoperative by said breech block and yieldingly movable, as the chamber descends, into position to engage said car-

tridge and to retain said cartridge in loading position during the return of the chamber and the withdrawal of said supporting device.

6. In a rocket apparatus, a casing, and a cartridge-replenishing mechanism comprising a cartridge holder and parallel links for maintaining said holder in position parallel to the axis of the casing during its movement from receiving to loading position.

7. A rocket apparatus having, in combination, a casing, a breech block fixed in said casing, a combustion chamber mounted for movement in said casing, a cartridge holder, and parallel links for supporting said holder within said casing, said holder being movable to a parallel loading position by the action of the descending combustion chamber.

8. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible container for said cartridges and means to feed said container and cartridges intermittently, and means to free said cartridges from said container as they approach transfer position.

9. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible tubular container for a plurality of cartridges arranged in axial series and means to advance said container and cartridges intermittently, and means to release said cartridges as they successively approach transfer position.

10. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible tubular container formed in two parts and adapted to hold a plurality of cartridges in axial series and means to advance said container and cartridges intermittently, and means to separate the two parts of said container to release the cartridges successively as they approach transfer position.

11. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible tubular container formed in two parts and adapted to hold a plurality of cartridges in axial series and means to advance said container and cartridges intermittently, and a pair of knives fixed in said casing effective to separate the parts of said container to release said cartridges successively as they approach transfer position.

12. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a tubular container formed of two pieces of flexible material having reinforced edges stitched to each other and a feeding device effective to intermittently engage and grip one of the reinforced portions to advance said container, and means to sever said stitches to release said cartridges successively.

13. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a container formed of two pieces of flexible material having strips of reinforced leather secured to each edge thereof, said strips being stitched together in pairs to form a tubular container and a device effective to grip one pair of said leather strips to intermittently advance said container, and means to separate said strips as they approach the transfer position of the cartridge contained therein.

14. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible tubular container for said cartridges and means to intermittently advance said container and cartridges, means to separate said container into two strips, a storage space in said casing, and means to advance said strips to said storage space.

15. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible tubular container for said cartridges and means to intermittently advance said container and cartridges, means to separate said container into two strips, thereby successively releasing the cartridges, separate storage chambers for each of said strips, and means to advance said strips to said chambers.

16. A rocket apparatus having, in combination, a casing, a combustion chamber mounted in said casing, means for feeding cartridges to said chamber comprising a flexible tubular container for said cartridges and means to intermittently advance said container and cartridges, means to separate said container into two strips, a storage chamber for said tubular container and cartridges, a storage space for said strips, and flexible walls separating said storage chamber from said storage space.

17. A rocket apparatus having, in combination, a casing, a combustion chamber, means for feeding cartridges to said chamber comprising a flexible tubular container for said cartridges and means to intermittently advance said container and cartridges,

means to separate said container into two strips, a storage chamber in said casing for said tubular container and cartridges, and separate storage chambers for each of said strips, each of said latter chambers having a flexible wall separating it from said first mentioned chamber, whereby the relative size of the latter chambers may be increased as the cartridges are consumed.

18. In a rocket apparatus, a combustion chamber and means for feeding cartridges to said chamber, said means comprising a flexible tubular container for a plurality of cartridges arranged in axial series, and means to maintain said cartridges in definite spaced relation in said container.

19. In a rocket apparatus, a combustion chamber, means for feeding cartridges to said chamber comprising a flexible tubular container for a plurality of cartridges arranged in axial series and means to advance said container and cartridges intermittently, and means to release said cartridges as they successively approach transfer position, portions of said container being creased between successive cartridges and maintaining said cartridges in spaced relation therein.

20. A rocket apparatus having, in combination, a combustion chamber, and means for feeding cartridges to said chamber, said means comprising a flexible tubular container for said cartridges having ribs on opposite sides thereon, said ribs being inwardly creased between successive cartridges to provide for expansion in traversing sharply curved passages and also maintaining said cartridges in definite spaced relation.

In testimony whereof I have hereunto affixed my signature.

ROBERT H. GODDARD.