R. H. GODDARD.

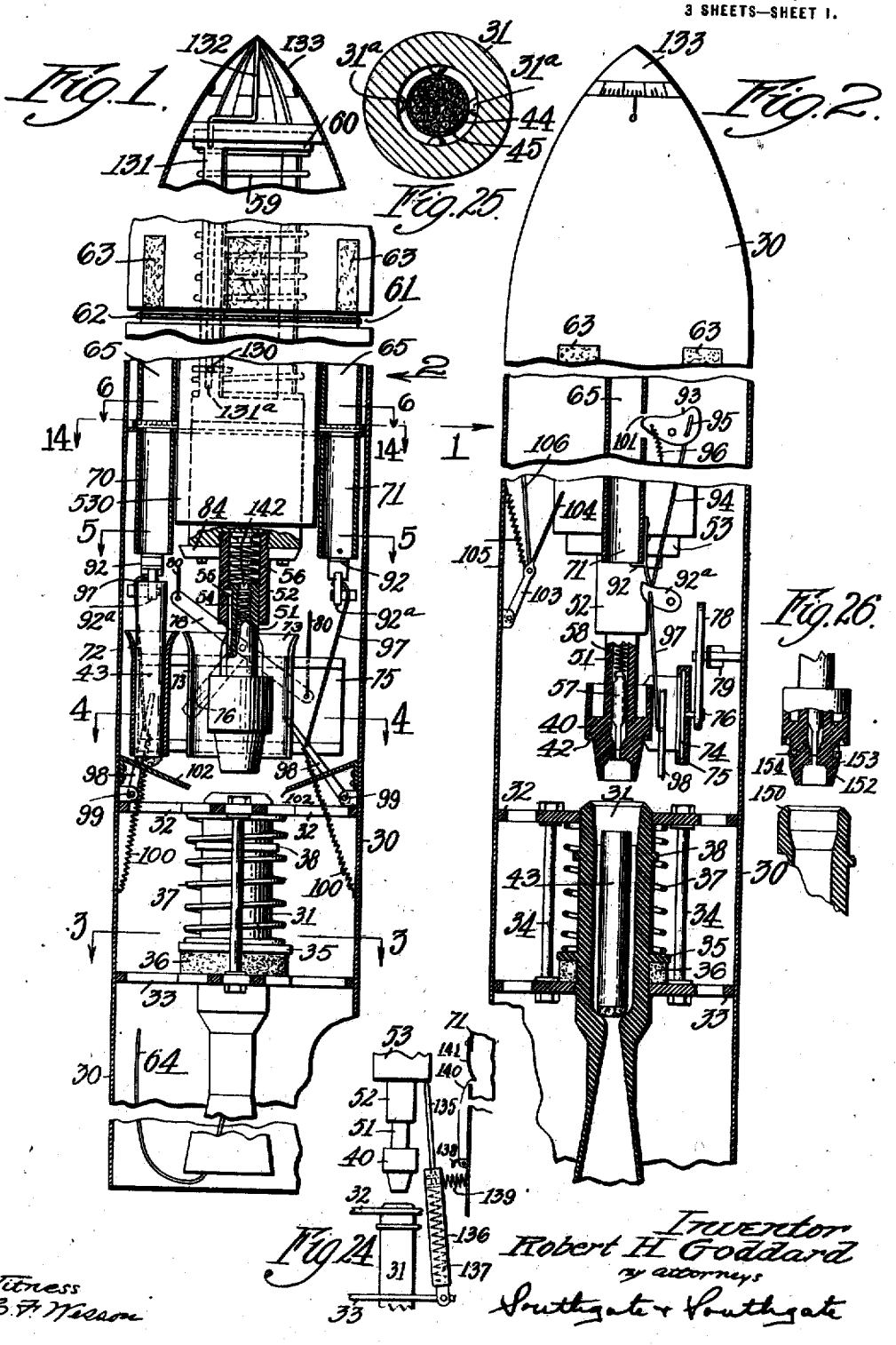
MAGAZINE ROCKET.

APPLICATION FILED NOV. 12, 1917.

1,341,053.

Patented May 25, 1920.

3 SHEETS—SHEET 1.



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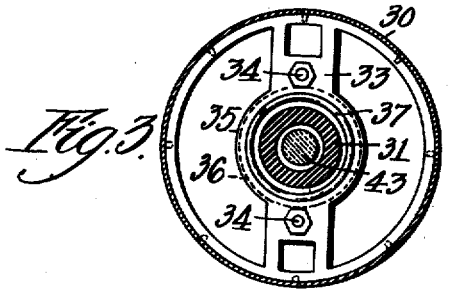

Fig. 3.

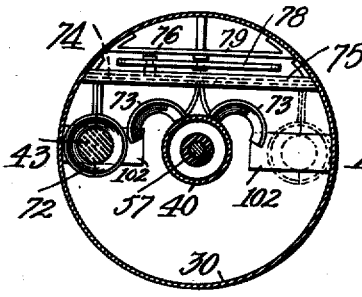

Fig. 4.

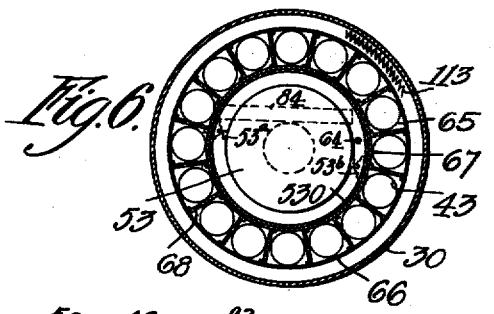

Fig. 6.

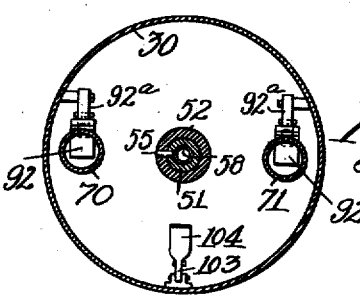

Fig. 5.

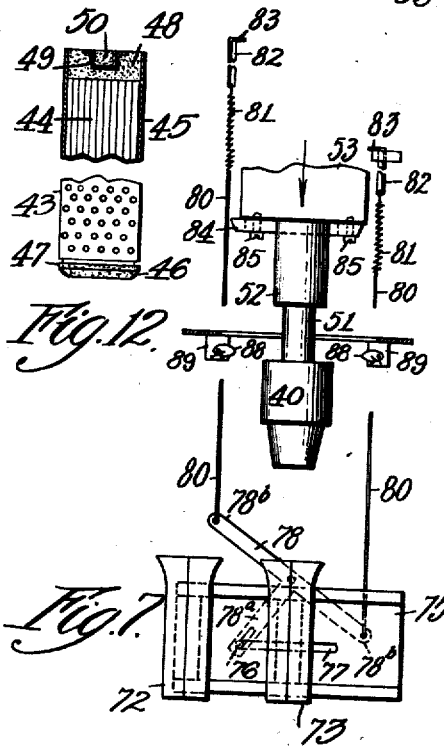

Fig. 12.

Fig. 7.

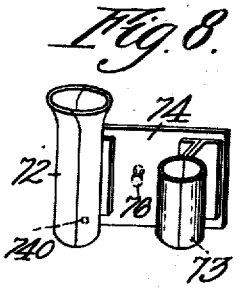

Fig. 8.

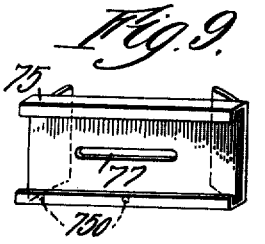

Fig. 9.

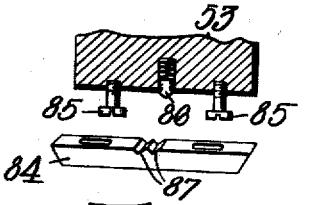

Fig. 10.

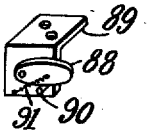

Fig. 11.

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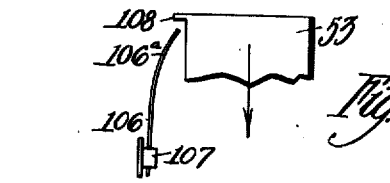
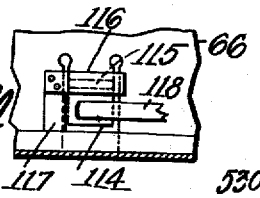


Fig. 20.



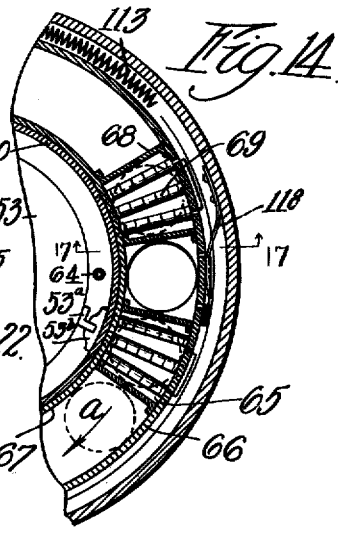


Fig. 14.

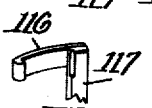


Fig. 21.

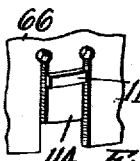


Fig. 22.

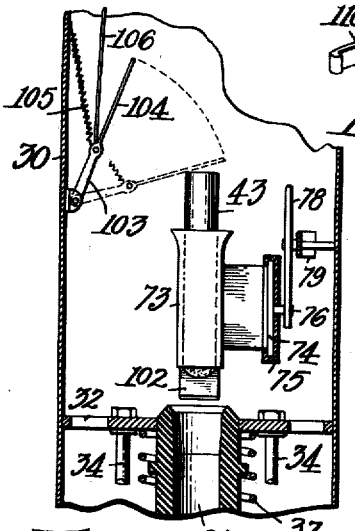


Fig. 13.

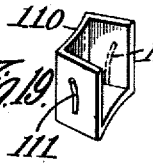


Fig. 19.

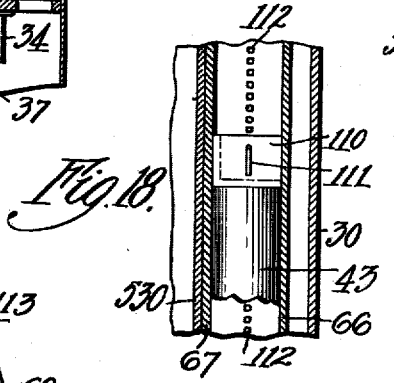


Fig. 18.

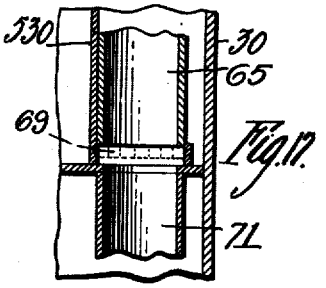


Fig. 17.

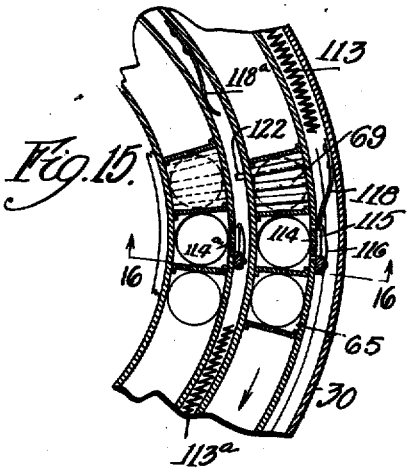


Fig. 15.

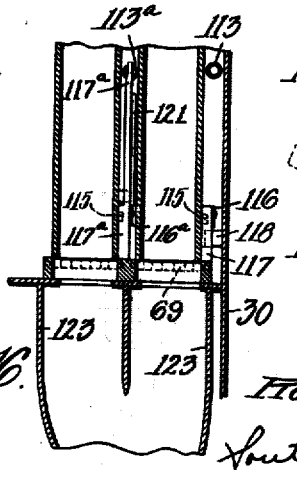


Fig. 16.

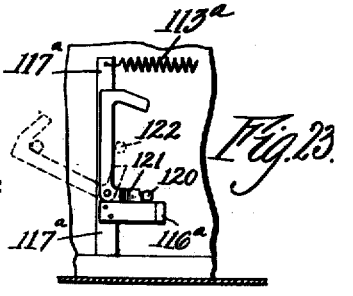


Fig. 23.

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MAGAZINE-ROCKET.

1,341,053. Specification of Letters Patent. Patented May 25, 1920.

Application filed November 12, 1917. Serial No. 201,472.

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 Magazine-Rocket, of which the following is a specification.

This invention relates to a magazine rocket of the type in which a plurality of relatively small charges of explosive are fired successively, the firing chamber being automatically reloaded after each charge is fired. One form of this type of rocket is shown in my prior U. S. Patent No. 1,103,503 dated July 14, 1914.

It is the general object of my present invention to improve the details of construction and method of operation of such magazine rockets to the end that more accurate and reliable results may be attained by their use, particularly for purposes of war.

With this general object in view, an important feature of my invention relates to the provision of cartridge feeding means so designed that the balance of the rocket is substantially preserved during the entire flight of the rocket. This is a matter of great importance as the flight of an unbalanced rocket is erratic and the desired objective can not be accurately attained. In the preferred embodiment of my invention this desirable result is attained by feeding the cartridges alternately from diametrically opposed magazine tubes.

Another feature of my invention concerns the provision of an axially rotatable cartridge magazine having a plurality of magazine tubes therein, and to the further provision of means for advancing the magazine angularly as soon as a pair of opposed tubes are emptied of cartridges.

Additional features of my invention relate to supporting devices for the firing chamber which permit limited axial movement thereof with the breech block, to means on the breech block for deflecting any escaping gases rearwardly, to improved locking and releasing devices for controlling the feed from the operatively positioned magazine tubes, to improved magazine constructions, and to other novel 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 magazine rocket;

Fig. 2 is a vertical sectional elevation taken in a plane at right angles to the plane of Fig. 1;

Figs. 3, 4, 5 and 6 are transverse sectional views taken along the lines 3—3, 4—4, 5—5, and 6—6 of Fig. 1;

Fig. 7 is a side elevation of the cartridge feeding mechanism;

Fig. 8 is a perspective view of the cartridge transferring devices, and the slide upon which they are mounted;

Fig. 9 is a similar view of the grooved support for the slide;

Figs. 10 and 11 are detail views, of the devices for reversing the action of the transferring device after each movement of the breech block;

Fig. 12 is a side view of one of the cartridges, partly broken away to show the interior construction;

Fig. 13 is a partial sectional side elevation in the plane of Fig. 2 showing the device for starting the fresh cartridge into the firing chamber;

Fig. 14 is a partial sectional view taken along the line 14—14 in Fig. 1;

Fig. 15 is a similar view showing a modification in which a double magazine is used;

Fig. 16 is a sectional elevation taken along the line 16—16 in Fig. 15;

Fig. 17 is a sectional elevation taken along the line 17—17 in Fig. 14;

Fig. 18 is a sectional elevation of a portion of a magazine tube showing the follower for the upper cartridge;

Fig. 19 is a perspective view of said follower;

Figs. 20, 21, 22 and 23 are detail views of elements to be described;

Fig. 24 (Sheet 1) is a side elevation of the devices controlling the firing of the last cartridge after the magazine is emptied;

Fig. 25 is a sectional view of the combustion chamber and cartridge, showing a slight modification, and

Fig. 26 is a sectional view of another modification.

Referring to Figs. 1 and 2 my improved magazine rocket comprises an outer casing

or tubular member 30 having a combustion chamber 31 supported therein. The chamber 31 is movably mounted upon cross bars 32 and 33 (Fig. 3) rigidly secured to the casing 30 and also connected together by bolts 34. The combustion chamber 31 has an annular flange 35 normally engaging a ring 36 of rubber or other suitable material resting upon the bar 33 and acting as a shock absorber. A coil spring 37 is interposed between the upper side of the flange 35 and the under side of the cross bar 32 and yieldingly holds the combustion chamber in the position shown in Figs. 1 and 2. This spring permits a slight upward movement of the chamber 31 after each explosion, such movement being limited by a flange 38 near the top of the combustion chamber which engages the cross bar 32 as the chamber rises.

A breech block 40 is mounted for axial movement above the combustion chamber 31, the block being shown in partially raised position in Figs. 1 and 2. The lower end of the breech block presents a conical form adapted to fit the flaring upper end of the combustion chamber, thus closing the chamber at the instant of explosion, but being readily separated therefrom. I have determined by experiment that the separation of the breech block and combustion chamber may be attained with much less strain upon the parts by permitting the chamber to rise slightly with the breech block until the maximum pressure of the gases has been somewhat reduced.

Above the conical lower end of the breech block I provide an annular flange 42 projecting outwardly and downwardly to deflect from the magazine any hot gases which may escape from the upper end of the combustion chamber.

The cartridge-engaging surface of the breech block is corrugated (Fig. 2) to permit access of a plentiful supply of air to the ignited cartridge.

A cartridge 43 is shown in firing position in Fig. 2 and is shown in detail in Fig. 12. The preferred form of cartridge as at present constructed comprises a plurality of rods 44 of cordite or other similar explosive surrounded by a thin sheath 45 of solid smokeless powder. This sheath 45 is preferably perforated, as indicated, to increase the rapidity of combustion. A wadding 46 is secured to the lower end of the sheath 45 and it is also desirable to place a felt pad 47 within the cartridge below the ends of the rods 44. To secure prompt ignition a small amount of rapidly-burning powder 48 is placed in the upper end of the cartridge around a receptacle 49 formed of solid smokeless powder, and containing fulminate 50. It will thus appear that the entire cartridge with the exception of the wadding 46 and felt pad 47 is of explosive material so that practically the entire weight of the cartridge is available for propulsion.

Reference to Fig. 2 shows that the cartridge is of somewhat less diameter than the combustion chamber 31 so that when centered by the breech block a clear space is provided entirely around the wall of the cartridge. It has been found by experiment that the provision of this annular space prevents the deposit of residue upon the walls of the combustion chamber after the explosion of the cartridge. It also enables me to increase the amount of explosive used in a combustion chamber of given strength, without reducing the efficiency of the rocket. In Fig. 25 I have shown a slight modification in which similar results are obtained but in which the cartridge is supported by guiding ribs 31^a which make line contact only with the cartridge.

The breech block 40 (Figs. 1 and 2) is provided with a shank 51 slidably mounted in a sleeve 52 extending downward from a shell 53. When my improved rocket is used for purposes of war the shell 53 may be filled with shrapnel or other explosive material and may be provided with a timing device as hereinafter described for exploding the shell after any desired interval. The shell 53 is guided in its longitudinal movement by ribs 53^a (Fig. 14) fixed thereto and engaging guides 53^b mounted on the inside of an inner casing 530 (Figs. 1 and 18) surrounding the shell 53. The shank 51 of the breech block 40 is provided with a key-way 54 (Fig. 1) and is held within the sleeve 52 by a pin 55 extending into said key-way. A heavy coil spring 56 within the sleeve 52 engages the upper end of the shank 51, holding the shank firmly against the stop pin 55. A firing pin 57 (Fig. 2) is slidably mounted in the breech block 40 and is normally held upward by a light coil spring 58. Above the shell 53 is a heavy coil spring 59, the upper end of which engages a plate 60 secured within the conical cap of the rocket.

I have found it desirable to use a breech block of considerable weight, and by the construction described I am enabled to utilize the shrapnel shell 53 to supply a portion of the needed weight, the breech block 40 and shell 53 rising together upon the explosion of a cartridge in the combustion chamber.

The spring 56 is interposed so that the breech block may engage the combustion chamber for an appreciable interval at the moment of explosion, the spring permitting a slight further downward movement of the shell 53 after the block is seated and thus providing maximum resistance at the moment of greatest chamber pressure. The combustion chamber should be as light as

is permissible, so that the greater part of the energy of the recoil immediately after firing will reside in the breech block.

A groove 61 (Fig. 1) is formed in the casing 30 and a ring of fulminating material 62 is provided in the bottom of the groove 61. This material is thus protected from accidental contact but may be readily engaged by the firing pin of a rocket firing device such, for instance, as is shown in my co-pending application Serial No. 201471, filed on even date herewith. Upon the firing of the fulminate 62, explosive charges 63 contained in pockets in the casing may be ignited to induce preliminary rotation of the rocket as fully described in my prior patent No. 1,102,653 dated July 7, 1914. At the same time a fuse 64 is ignited which extends downward to the lower end of the casing 30 and there enters the funnel-shaped nozzle of the combustion chamber. The fuse 64 extends through the wadding of the first cartridge to the explosive therein and this first cartridge is accordingly exploded by the timed action of the fuse. Succeeding charges are exploded by the firing pin 57 which continues its downward movement after the seating of the breech block, thus striking the fulminate in the upper end of the cartridge in the combustion chamber and exploding the charge.

The cartridges 43 are carried in magazine tubes or compartments 65 (Figs. 6 and 14) formed by concentric shells 66 and 67, and intermediate partitions 68. These shells and partitions form a magazine structure which is rotatably supported upon a plurality of rollers 69 having fixed bearings and extending around the greater portion of the circumference of the rocket. These rollers support the lower end of the magazine and also support the cartridges contained therein.

In Fig. 15 I have indicated a double magazine structure in which inner and outer magazine members are used, each member being constructed substantially as above described.

At diametrically opposed points in the casing, magazine extensions 70 and 71 (Fig. 1) are provided through which the released cartridges pass to the transferring devices which will now be described. The transferring devices comprise a pair of holders 72 and 73 (Fig. 8), fixed to a slide 74 and each comprising two separable spring arms forming a cylindrical tube having a flaring upper end. The slide 74 is mounted to move transversely in guide ways formed in a frame 75 rigidly secured to the casing 30. A stud 76 extends from the back side of the plate 74 through a slot 77 in the frame 75 and is engaged by a slotted arm 78^a (Fig. 7) of a three-armed lever 78 pivoted upon a brace 79 (Fig. 4) fixed to the casing 30. The horizontal arms 78^b of the lever 78 are connected by wires 80 and springs 81 to slides 82 having projecting lugs 83 adjacent the path of the shell 53.

A bar 84 (Fig. 10) is secured to the lower end of the shell 53 by screws 85 extending through slots in said bar. A spring-pressed plunger 86 in the shell 53 is positioned to engage one or the other of notches 87 in the bar 84, thus yieldingly retaining the bar in one or the other of its two operative positions.

After an explosion in the combustion chamber, the breech block and shell will rise and one end of the bar 84 will engage a lug 83, thus producing upward movement of the corresponding spring 81 and wire 80, and swinging the lever 78 to move the slide plate 74 to one or the other of its extreme positions, in which it is yieldingly retained by a stud 740 (Fig. 8) engaging one of two depressions 750 (Fig. 9) in the frame 75. With the parts as shown in Fig. 7, the holder 72 will be positioned to receive a cartridge from the magazine extension 71, and the holder 73 will position its cartridge for insertion into the combustion chamber 31.

Upon the next upward movement of the breech block the movement of the slide 74 must be reversed, to thereby present the cartridge in the holder 72 for insertion in the combustion chamber and to move the holder 73 into position to receive a fresh cartridge from the magazine. Such reversal of movement is accomplished by changing the operative position of the bar 84 so that it will engage the opposite lug 83 and move the lever 78 in the opposite direction.

For reversing the position of the bar I provide a pair of pivoted dogs 88 (Fig. 11) each mounted upon a fixed bracket 89 and held in engagement with a stop pin 90 by a light spring 91. As the breech block 40 and shell 53 rise the dogs will swing idly upward without affecting the position of the bar 84. The outer ends of said bar are beveled as shown in Fig. 10 and upon the descent of the breech block and shell the one projecting end of the bar will engage one of the dogs 88 and will thus be moved transversely of the shell 53, thereby reversing the position of the bar 84, and consequently reversing the operation of the transferring device above described.

The spring construction of the holders 72 and 73 permits the two parts of the holder positioned above the combustion chamber to separate when engaged by the descending breech block, as shown in Fig. 1, thus permitting the continued downward movement of the breech block and releasing the cartridge contained in the holder.

I will now describe the devices for releasing the cartridge in one of the magazine extensions 70 and 71 when one of the holders

72 or 73 is positioned to receive said cartridge and also the means for locking the cartridges above as the released cartridge moves downward. Referring to Figs. 1 and 2, I have shown a spring stop 92 and a lever arm 92^a for each magazine extension 70 or 71 and a coöperating locking plate 93 for each stop 92. A link 94 connects each arm 92^a and locking plate 93, the connection with the plate 93 being a lost-motion connection including a slot 95 in the plate. This plate 93 is normally held in operative position by a spring 96. A link 97 connects the arm 92^a to a lever 98 pivoted to the casing at 99 and drawn downward by a tension spring 100. The levers 98 are positioned for engagement by the corresponding cartridge holders 72 or 73 as the slide 74 moves transversely in its guide 75. When the holder 72 is positioned beneath the magazine extension 70 the corresponding lever 98 is moved to the position shown at the left in Fig. 1, thus raising the arm 92^a and thereby withdrawing the stop 92, and hence releasing the cartridge in the extension 70. At the same time the link 94 moves upward in the slot 95, thus permitting the locking plate 93 to become operative under the tension of the spring 96 and locking the next higher cartridge in the magazine extension.

Upon the next movement of the transferrer slide 74, the lever 98 will be released to move downward under the tension of the spring 100, such movement replacing the stop 92 again in locking position and releasing the cartridge held by the plate 93. The plate 93 extends through an opening 101 in the side of the extension 70 or 71 and the stop 92 is positioned at the lower end of the extension.

As the cartridges are positioned in the holders 72 or 73 the lower ends of the cartridges engage stop-plates 102 so inclined that a smooth and easy movement of the cartridge to loading position is assured with a minimum amount of friction upon the cartridge.

In order to prevent a too sudden blow upon the cartridge by the descending breech block I provide means for starting the cartridge into the combustion chamber before actual engagement thereof by the breech block. Such means is best shown in Fig. 13 and comprises an arm 103 pivoted on the casing 30 and having a flexible extension 104. This arm is normally held in the full line position in Fig. 13 by a tension spring 105. A flexible rod or wire 106 is pivoted to the arm 103 and extends upward through a guide or bearing 107 to a position in which its curved inner end 106^a will be engaged by a lug or projection 108 formed on the top of the shell 53. As the breech block and shell move downward the rod 106 and arm 103 are also moved downward and the flexible extension 104 engages the cartridge 43 in the holder 72 or 73 and gives the cartridge an initial downward movement into the combustion chamber 31. As the rod 106 moves downward in its bearing 107 the curved end 106^a moves outward until it clears the lug 108, thus releasing the arm 103 which is immediately returned to inoperative position by the spring 105. The conical extension 41 of the breech block 40 thereafter engages the cartridge, forcing it into the combustion chamber and at the same time spreading apart the two members of the holder 72 or 73 by engagement with the flaring top thereof.

A cartridge follower 110 (Figs. 18 and 19) is provided in each magazine tube to prevent rebound of the cartridges after downward movement in the tube. The follower comprises a hollow block having a wire spring 111 extending outward from each side in position to engage any one of a series of holes 112 formed in the side walls 68 of the magazine tubes. The free ends of the springs extend upward and thus have a ratchet action, locking the follower against upward movement but permitting free downward movement thereof. This simple device effectually prevents rebound or upward movement of the cartridges in the tubes.

I will now describe the mechanism for releasing and advancing the magazine angularly after a pair of diametrically opposed magazine tubes have been emptied. Coil springs 113 (Fig. 14) partially encircle the outer magazine shell 66, one end of each spring being attached to the casing 30 and the opposite end to the shell 66 in such a way that the spring tends constantly to advance the magazine in the direction of the arrow *a* in Fig. 14. The shell 66 is provided, adjacent the lower end of each tube or compartment of the magazine, with a spring tongue 114 (Fig. 22) having a lug or projection 115 formed thereon. So long as a cartridge remains in the tube the tongue 114 is held in normal position and one end of the lug 115 engages a hook 116 while the opposite end engages a stand 117, thus preventing movement of the magazine in either direction. A flat spring 118 (Figs. 14 and 20) engages the tongue 114 of the operatively positioned magazine tube and as soon as the tube is emptied the tongue is forced inwardly by said spring 118 so that the lug 115 is disengaged from the stand 117 and the magazine is free to advance under the influence of the spring 113 until the corresponding lug 115 of the succeeding magazine compartment engages the stand 117 and hook 116 and is locked thereby.

Where a double magazine is employed the additional mechanism shown in Figs. 15, 16 and 23 is required. The inner magazine is normally held slightly out of operative po-

sition by a stop pin 120 (Figs. 16 and 23) on the magazine engaging a latch 121 pivoted to an upward extension of the stand 117ª of the inner magazine. The spring 113ª for advancing the inner magazine preferably has one end secured to a further upward extension of the stand 117ª as shown in Fig. 23.

After the outer magazine has been emptied the next advance movement of the now empty magazine will cause a pin 122 (Fig. 15) carried thereby to engage and move the latch 121, thus releasing the stop pin 120 and permitting the inner magazine to advance to operative position where it will be locked by the stand 117ª and hook 116ª as previously described. Furthermore the hook-shaped end of the latch 121 will permanently engage the stop pin 122 and prevent further movement of the empty outer magazine. At the same time a flat spring 118ª mounted on the outer magazine will be brought into engagement with the operatively positioned tongue 114ª of the inner magazine and the operation of intermittently advancing the inner magazine will thereafter continue as above described. Double magazine extensions 123 (Fig. 16) are necessary when the double magazine is used, the two parts of each extension merging into a single discharge opening above the receiving position of one of the holders 72 and 73.

As these rockets are commonly used the full supply of cartridges will be exhausted before the rocket reaches its destination, and the shrapnel shell 53 is therefore provided with an independent timing device causing it to explode after a definite period of flight. Such timing devices for shrapnel and other shells are well-known in the art and form no part of my present invention, and for this reason are not shown in detail herein. It is sufficient for present purposes to state that the timing device of the shell may be adjusted by angularly adjusting a pin 130 (Fig. 1). In order to permit such angular adjustment without interfering with the longitudinal movement of the shell 53 with the breech block 40 I provide a skeleton sleeve 131 rotatably mounted below the plate 60 previously described as secured to the conical portion of the rocket. The sleeve 131 is provided with a longitudinal slot 131ª through which the pin 130 extends, said slot permitting free longitudinal movement of the shell 53 but determining the angular position of the pin 130. Adjustment of the sleeve 131 is accomplished by a rod 132 fixed to the sleeve and offset to extend upward along the axis of the rocket. A cap 133 is fixed to the end of the rod 132, said cap being graduated as shown in Fig. 2 and an index or zero line being provided upon the casing 30. The sleeve 131 and cap 133 are thus constructed to move together, and adjustment of the cap by reference to the graduations thereon causes a similar adjustment of the sleeve 131 and timing pin 130. The timing of the shrapnel shell is thus readily accomplished.

In order to secure the maximum explosive effect upon the explosion of the shrapnel shell 53 it is desirable that a final cartridge should be simultaneously exploded in the combustion chamber 31. Such cartridge may be filled with especially destructive high explosive if desired. To prevent premature firing of this final cartridge I have provided the special devices shown in Fig. 24 for causing the breech block 40 to descend gently upon said final cartridge.

These devices comprise a plunger 135 mounted in a swinging cylinder 136 and normally held upward by a spring 137. The cylinder 136 may conveniently be pivoted upon the lower cross bar 33. The plunger 135 is normally held out of the path of the breech block by a latch 138 which engages the upper edge of the cylinder 136 and holds the same in substantially vertical position against the action of a compression spring 139. A cord or wire 140 connects the latch 138 to the end of a flat spring 141 mounted on the side of a magazine extension 71ª and normally held outward by the cartridge therein. When the last cartridge passes into the holder, however, the spring is free to move into the extension, thus pulling upward the cord or wire 140 and raising the latch 138. The cylinder 136 is thus released and swings inward, bringing the plunger 135 into the path of the descending breech block 40 and shell 53. The spring 137, and the air resistance within the cylinder 136, combine to reduce the velocity of the breech block without actually preventing movement thereof into position to close the combustion chamber. The movement is so gradual, however, that the inertia of the firing pin 57 is not sufficient to fire the cartridge.

The shank 51 has a hole 142 in its upper end, and when the shrapnel shell explodes, the force of the gases is exerted through this hole 142 upon the firing pin 57 which in turn explodes the final cartridge in the combustion chamber.

As the breech block is simply pressed against the chamber 31 when the first cartridge is fired and there is no compression of the spring 56, it is desirable that this first cartridge be of less strength than the succeeding charges.

In Fig. 26 I have shown a slight modification in the construction of the combustion chamber and breech block. In this figure the seat in the combustion chamber 150 is cylindrical in its outer portion. The breech block 151 is formed with a short conical portion 152 at its extreme lower end, above

which is provided a cylindrical portion 153 closely fitting the outer end portion of the combustion chamber. A packing ring 154 may be provided to insure a gas-tight fit of the breech block within the chamber. The further details of construction of the breech block are similar to the form previously described, and the operation thereof is identical.

The operation of the several parts of my improved rocket has been fully set forth in connection with the detailed description thereof, and repetition is considered unnecessary.

Many important advantages of my present construction will be readily apparent to those skilled in the art. Particular importance is attached to the provision herein of means for alternately removing cartridges from diametrically opposed magazine tubes until the cartridge supply is exhausted. In this way the rocket is never unbalanced by more than the weight of a single cartridge, which weight is negligible when compared to the weight of the entire rocket.

Having thus described my invention, it will be evident that many changes and modifications can be made therein by those skilled in the art within the scope of my invention 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 magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, and means to transfer cartridges alternately from diametrically opposed containers to said combustion chamber.

2. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, a transferring device for each of two diametrically opposed containers, and means to render said transferring devices alternately operative.

3. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, and means to transfer cartridges alternately from diametrically opposed containers to said combustion chamber, said means comprising transversely movable cartridge holders each formed in parts separable by the breech block as it returns to normal engagement with said chamber.

4. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, a transferring device for each of two diametrically opposed containers, and means to render said transferring devices alternately operative, said transferring devices being mounted on a slide capable of transverse movement in said rocket, and said means including mechanism for giving said slide a transverse movement after each cartridge is discharged.

5. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, a transferring device for each of two diametrically opposed containers, and means to render said transferring devices alternately operative, said transferring devices being mounted on a slide capable of transverse movement in said rocket, and said means including an actuating member operative to move said transferring devices on each upward movement of the breech block, and devices to move said member to an alternate operative position on each return movement of said breech block.

6. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, means to transfer cartridges from said containers to a position in line with said combustion chamber, and means to give each of said cartridges an initial movement into said chamber before the return of said breech block.

7. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge magazine tubes, each adapted to contain a supply of cartridges, a transferring device for each of two diametrically opposed tubes, and means to alternately release a cartridge in each one of said tubes when the corresponding transferring device is in position to receive said cartridge.

8. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge magazine tubes, each adapted to contain a supply of cartridges, a transferring device for each of two diametrically opposed tubes, means to release a cartridge in one of said tubes when the corresponding transferring device is in operative position, and means to simultaneously lock the cartridge next above said released cartridge.

9. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge magazine tubes, each adapted to contain a supply of cartridges, diametrically opposed magazine extensions, a transferring device for each extension, means to release a cartridge in one of said extensions when the corresponding transferring device is in operative position, and means to simultaneously lock the cartridge

next above said released cartridge, said releasing and locking means comprising a separate holding stop for each extension, and devices for rendering one of said stops operative and the other stop inoperative alternately.

10. A magazine rocket comprising a combustion chamber, yielding holding devices for said chamber permitting limited axial movement thereof, a breech block, holding devices for said breech block permitting greater axial movement thereof, thereby separating said block and chamber, and means to insert a fresh cartridge in said chamber while said chamber and block are separated.

11. A magazine rocket comprising a combustion chamber, a movable breech block, and means permitting slight axial movement of said chamber with said block when the charge is exploded.

12. In a magazine rocket, in combination, a combustion chamber and a movable breech block, said chamber having a tapered seat therein and said breech block having a conical end portion fitting said tapered seat, said end portion being also recessed to receive and position the adjacent end of a cartridge contained in said combustion chamber.

13. In a magazine rocket, in combination, a combustion chamber, and a movable breech block, said breech block having a conical extension seating in said chamber and having also an annular gas deflector surrounding said conical extension.

14. A magazine rocket having, in combination, a combustion chamber, a relatively movable breech block, said breech block comprising a portion normally engaging the combustion chamber, and a second portion of greater size by which said first portion is yieldingly supported, and a spring yieldingly resisting axial movement of said second portion.

15. In a rocket, a combustion chamber, a breech block, said chamber and block being relatively movable, a cartridge, and means to feed said cartridge to said combustion chamber, said cartridge being of less diameter than said chamber, whereby a clear annular space separates said cartridge and chamber when the cartridge is in position for firing.

16. In a rocket, a combustion chamber and a cartridge therefor, said cartridge and chamber being of such diameters that a substantially unobstructed space is interposed between the cylindrical walls of the cartridge and chamber.

17. A magazine rocket comprising a combustion chamber, a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, means to feed cartridges from said containers to said chamber, and means in each container to prevent upward movement of the cartridge therein.

18. A magazine rocket comprising a combustion chamber, a breech block, said chamber and block being relatively movable, a plurality of cartridge containers embodied in a rotary magazine, means to lock said magazine until two diametrically opposed containers are emptied, and means to thereupon advance said magazine to place fresh containers in feeding position.

19. A magazine rocket comprising a combustion chamber, a rotary cartridge magazine, means to feed cartridges successively from said magazine to said chamber, a second magazine concentric with said first magazine, and means to render said second magazine operative upon exhaustion of the first magazine.

20. A magazine rocket comprising a combustion chamber, a rotary cartridge magazine, means to feed cartridges successively from said magazine to said chamber, a second magazine concentric with said first magazine, and means to advance said second magazine to operative position, said means being held inoperative by said first magazine until the cartridges in the latter are exhausted.

21. A magazine rocket having, in combination, a combustion chamber and a relatively movable breech block, said breech block comprising a portion charged with explosive material.

22. A magazine rocket having, in combination, a combustion chamber, a relatively movable breech block, said breech block comprising a portion charged with explosive material, and means to fire said material at a definite time after the ignition of the rocket.

23. A magazine rocket having, in combination, a combustion chamber, a relatively movable breech block, said breech block comprising a portion charged with explosive material, means to fire said material at a definite time after the ignition of the rocket, and manual means for adjusting said firing means, said manual means preserving said adjustment while permitting longitudinal movement of the breech block.

24. A magazine rocket having, in combination, a plurality of cartridges, an explosive shell, separate means for firing said cartridges and said shell, and means to prevent the firing of the last cartridge until the explosion of said shell.

25. A magazine rocket having, in combination, a plurality of cartridges, an explosive shell, separate means for firing said cartridges and said shell, and means to fire the last cartridge by the explosion of said shell.

26. A magazine rocket having, in combination, a plurality of cartridges, a magazine

therefor, a combustion chamber and a movable breech block, said breech block comprising an explosive shell and also a firing pin operated by inertia for exploding said cartridges successively in said combustion chamber, means to prevent the operation of said firing pin on the last cartridge upon exhaustion of said magazine, and additional means to render said firing pin again operative upon the explosion of said shell.

27. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge magazine tubes, each adapted to contain a supply of cartridges, diametrically opposed magazine extensions, a transferring device for each extension, means to release a cartridge in one of said extensions when the corresponding transferring device is in operative position, and means to simultaneously lock the cartridge next above said released cartridge, said releasing and locking means for each extension comprising a stop for the lower cartridge therein, a lock for the cartridge next above, and means for simultaneously rendering said stop and lock operative and inoperative alternately.

28. In a magazine rocket, in combination, a combustion chamber having a conical seat and a cylindrical end portion, and a relatively movable breech block having a conical end portion and also a cylindrical portion closely fitting the outer cylindrical end portion of said chamber.

29. In a magazine rocket, in combination, a combustion chamber, and a relatively movable breech block having a conical end portion, a cylindrical portion closely fitting the outer end portion of said chamber, and a packing ring in said cylindrical portion effective to prevent upward escape of gas from said chamber.

30. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, and means to transfer said containers successively to said combustion chamber without substantially disturbing the relative distribution of weight in said rocket.

31. A magazine rocket comprising a combustion chamber and a breech block, said chamber and block being relatively movable, a plurality of cartridge containers, and means to transfer said containers successively to said combustion chamber, and while maintaining said rocket in substantial balanced condition relative to the longitudinal axis thereof.

In testimony whereof I have hereunto affixed my signature.

ROBERT H. GODDARD.