United States Patent Office 3,102,477 Patented Sept. 3, 1963

3,102,477

ROCKET SIGNAL DEVICE

Russell O. Stefan, Downey, and Anton G. Lang, Los Angeles, Calif.; said Anton G. Lang assignor to said Russell O. Stefan

Filed Nov. 21, 1961, Ser. No. 153,953
9 Claims. (Cl. 102—37.6)

This invention relates to pyrotechnic signal producing devices and represents an improvement over the device entitled "Flare Gun" which is disclosed in our copending application for U.S. Letters Patent Serial No. 72,901, filed December 1, 1960, now Pat. No. 3,044,360. The device disclosed in said application comprised a tubular launcher embodying a spring impelled striker, the diameter of said launcher approximating that of a fountain pen, and a cheap, single-use cartridge of slightly larger diameter which screws into the launcher and provides, in one package: a firing barrel; a projectile containing a signal charge and a readily ignitable fuse charge; and a percussion cap detonatable by impact of the launcher striker therewith to both ignite said fuse charge and propel said projectile to a height of approximately 100 yards.

It is an object of the present invention to provide such a signal device in which the fuse charge is ignited in a manner to delay its burning and thus assure that a substantial portion of the mass of the fuse will remain unconsumed during a considerable portion of the upward flight of the projectile, thereby contributing to the momentum aiding in the ascent of the projectile and also deferring the ignition of the signal charge until the projectile has reached an altitude where it will be an effective signal.

Another object of the invention is to provide such a device in which the burning of the fuse charge, thus prolonged, applies a sustained rocket thrust axially to the projectile in the direction the device is pointed when fired, thereby increasing the altitude attained by the projectile.

A further object of the invention is to provide such a cartridge, the shell of which is injection cast of plastic material thereby greatly lowering the cost of such cartridges.

Prior attempts to employ cast plastic as the material for cartridge shells have encountered the tendency for percussion caps mounted in such shells misfiring more frequently than is allowable.

Still another object of the present invention is the provision of a plastic cartridge shell for a pyrotechnic signal device or the like in which misfiring of the percussion cap is practically eliminated.

It is also an object of the present invention to provide a novel signal-charge-containing projectile, adapted for use in such a cartridge, and a novel method of making said projectile which contributes substantially to the attainment of the foregoing objects.

The manner of accomplishing the foregoing objects as well as further objects and advantages will be made manifest in the following description taken in connection with the accompanying drawings in which

FIG. 1 is an elevational view, drawn approximately to full scale, of a preferred embodiment of the invention held erect with the firing pin cocked ready for firing.

FIG. 2 is an enlarged, fragmentary, sectional view of the invention taken on line 2—2 of FIG. 1, and shows the firing pin of the invention in safety position.

FIG. 3 is a view similar to FIG. 2 illustrating the firing of said cartridge with the projectile only partly extended from the barrel of the cartridge. This view shows how the rocket fuse charge in the projectile is ignited only in a

centralized area of precisely limited size as the projectile is propelled from the cartridge.

FIG. 4 is a view similar to FIG. 3 and illustrates the projectile in full flight upwardly under the impulse of the momentum of its discharge from the cartridge, aided by the rocket thrust produced by the burning of the rocket fuse charge of the projectile.

FIG. 5 is an enlarged sectional view to a scale of approximately twice actual size, of the cartridge of the invention with the elements thereof separated axially so that they may be individually illustrated as they appear prior to assembly in the cartridge.

FIG. 6 is a diagrammatic illustration of the steps involved in the method of manufacture o fthe flare projectile of the invention.

Referring specifically to the drawings, the present invention is illustrated therein as embodied in a pyrotechnic signal producing device 10 which includes a launcher 11 and a cartridge 12.

The launcher 11 comprises a cylindrical tube 13 which is about ½ inch in outside diameter and is internally threaded at its opposite ends. Formed longitudinally in the tube 13 is a firing slot 14 having a safety notch 15 formed laterally therefrom near its upper end and a cocking notch 16 formed in the opposite direction laterally from said firing slot at the opposite end of the latter. Screwed into the internal threads in the upper end of the tube 13 and secured against rotation by a punched indentation 17 in the tube is a firing pin stop 18, this having an axial bore 19 with a deep conical downward counterbore 20.

Closely fitting and freely slidable within the tube 13 is a cylindrical firing pin 25, the upper end of which is tapered to fit flush within the conical counterbore 20 and terminates in a tapered striker 26 which is of a smaller diameter than the bore 19 so as to pass readily therethrough. The firing pin 25 is provided with a radial hole 27, just below the tapered upper end thereof, and a cocking pin 28 having a cylindrical knurled head 29 is driven into the hole 27 so as to be permanently assembled with the firing pin 25 and restrict movement of the latter in the tube 13 to the limits defined by the firing slot 14 and notches 15 and 16.

A coiled expansion spring 30 fits slidably into the lower end of the tube 13 and is held compressed against the lower end of the firing pin 25 by a screw plug 31 which screws into the threads in the lower end of the tube 13.

The cartridge 12 of the device 10 constitutes the ammunition which is used with the launcher 11 in each firing of the device 10, and each cartridge provides its own firing barrel so that it is unnecessary for the launcher to be provided with such a barrel.

Referring to FIG. 5 which illustrates the component parts of a cartridge 12 separated axially in the order in which they are assembled to form the cartridge, the three principal components of the cartridge are seen to be a shell 32, a projectile 33 and a percussion cap 34.

The shell 32 may be die-cast of aluminum or of the alloy known as die cast metal but, to lower the cost of the cartridge 12 this shell is preferably injection molded of a plastic of high tensile strength. The only plastics which have proved satisfactory in making the shell 32 to date are polycarbonate resin which is known in the trade as "Lexan," and acetal resin which is known in the trade as "Delrin."

The shell 32 includes a cylindrical firing barrel 35 which preferably has an inside diameter of approximately .575 inch and a wall thickness of at least .05 inch. The upper end of the barrel 35 is open and the lower end is

united integrally with a shell base 40 on which is provided an externally threaded nipple 41. The base 40 closes the lower end of the barrel 35 and has a deeply concave conical inner surface 42 which forms a gas expansion pocket at the lower end of the cylindrical firing chamber 43 provided by the barrel 35. The juncture of the conical surface 42 with the chamber 43 forms an annular shoulder 44.

Formed axially in the nipple 41 is a bore 45 having a counterbore 46 the latter forming an annular shoulder 47 at its juncture with said bore. The counterbore 46 is designed to tightly receive a metal reinforcing sleeve 48 which is provided with an inturned flange 49 at its inner end which is thus brought to rest against the annular shoulder 47 of the shell 32. The internal diameter of the sleeve 48 is such as to tightly receive the percussion cup 34 and the latter is pressed into said sleeve. The function of the sleeve 48 is to provide a relatively rigid base for supporting the cap 34 so as to insure detonation of the latter when the device 10 is fired. In the absence of such a reinforcement the plastic material of which the shell 32 is made was found inadequate to prevent frequent misfiring of the caps mounted therein, a circumstance which would be intolerable in the signaling device to which this invention relates. Providing shell 32 with the reinforcing sleeve 48, however, has practically eliminated failures from this source.

The percussion cap 34 is preferably a center fire primer cap of substantial power and the cap of this type identified as the No. 250 Magnum Rifle and Pistol Cap put out by Cascade Cartridge Co., Lewiston, Idaho, has proved entirely satisfactory.

Many difficulties were encountered in the development of projectile 33 to the point where this satisfactorily performs its intended function in the invention. The preferred method in the present invention of producing the projectile 33 is diagrammatically illustrated in FIG. 6. The principal element of the projectile 33 is a very thin-walled metal cup which is preferably made of aluminum but which can also be made of other relatively combustible metals such as zinc, magnesium or "die casting metal." The wall of cup 55 is preferably about .005 inch in thickness. The method of utilizing this cup in the manufacture of projectiles 33 includes the use of a steel platform 56 which is provided with a multiple of cylindrical recesses 57, each being of a size to just snugly receive one of the cups 55. Each of the recesses 57 is provided with a cup ejection hole 58. The six steps of the method of the invention for making the projectiles 33 are illustrated in adjacent recesses 57 of the platfrom 56. In actual practice the platform 56 is provided in multiples and where a step involves a pressing operation a different press is equipped with a bank of plungers, one for each of the recesses 57, and that step is performed on all these recesses in a single operation of that press.

The process starts with supplying each of the recesses 57 of one of the platforms 56 with a cup 55 and the filling of all the cups in the platform with a flare signal composition which constitutes the signal charge of the projectile. Where it is desired that the projectile 33 give a bright red light as a signal, this composition is made up of approximately 70% of powdered magnesium (200 mesh), 25% of potassium perchlorate, 4% of strontium oxalate (for red color), and about 1% of gum arabic for moistening the mixture. Where the gum arabic needs thinning a trace of dextrine or linseed oil is added. When this mixture has the form of a relatively dry paste it is forced into the cups 55 to fill the same, as shown in recess *a* in FIG. 6.

The next step of the process, illustrated in recess *b*, consists in placing the platform 56 in a press which is provided with a bank of plungers 59, one for each of the recesses 57 and lowering these plungers to press the composition occupying the cups 55 to greatly compact this in these cups and form this composition into a signal

charge 60. The lower end of each plunger 59 is semispherical in shape and has a rounded tit 61 formed axially thereon so as to impress this shape onto the exposed surface of each of the signal charges 60 when this step has been completed. In order to get the desired compactness of the material of the composition thus pressed into the cup 55 to form a signal charge 60, a pressure is applied on this mixture by each of the plungers 59 of from 1500 to 4000 pounds in the step just described.

The next step of the process of making the projectile 33 is illustrated in the showing of recess *c* in FIG. 6 and this is accomplished by placing the platform 56 in the press having a bank of plungers 62 the lower face of each of which is flat with an annular rounded channel which curls the upper edge of the cup 55 inwardly so as to form an inturned flange 63 thereon which performs the dual function of strengthening the mouth of the cup 55 during the firing of the projectile 33 while at the same time retaining the contents of the projectile therein during the upward travel of the projectile when the device 11 is fired.

The next step of the process of making projectiles 33 is to set the plate 56 aside for approximately twelve hours to let the signal charges 60 formed in the shell 55 to thoroughly dry out.

A composition is now prepared for forming a rocket-fuse charge 64 in the mouth of the projectile 33. This composition preferably comprises 75% of meal-prime (⅔ of which is blasting powder and ⅓ charcoal) and 25% of the composition used in forming signal charge 60. This is made into a dry paste and packed into the hollow space in the mouth of each of the cups 55 and then pressed tightly therein by placing the platform 56 in a press equipped with a bank of rams 65 as illustrated in connection with recess *e* in FIG. 6.

The platform 56 loaded with projectiles 33 on which all of the foregoing steps have been performed so as to complete these projectiles is now set aside to permit thorough drying of the rocket-fuse charges 64, after which the projectiles 33 are ejected from their recesses 57 by a bank of ejector rods (not shown) extending through the holes 58.

The projectile 33 has an outside diameter which permits it to very loosely fit into the firing chamber 43 of the shell 32 when assembling a cartridge 12. When this assembly takes place the projectile 33 is preceded into the chamber by a cardboard disk 70 having a small hole about 1/16 of an inch in diameter. When the disk 70 comes to rest on the shoulder 44 therefore it supports the projectile 33 with the upper surface of the disk close to the adjacent surface of the rocket-fuse charge 64 with the central hole 71 of the disk exposing only a small axial portion of that surface of the charge 64, as shown in FIG. 2. To complete the assembly of the cartridge 12, a second cardboard disk 72 of the same diameter as the disk 70, but imperforate, is inserted in the mouth of firing chamber 43 so to rest against the upturned bottom of the projectile 33, the latter being inverted before insertion into the shell 32. Both of the disks 70 and 72 have an outside diameter which snugly fits the firing chamber 43. The final step in assembly of the cartridge 12 comprises painting the upwardly exposed face of the disk 72 and the exposed mouth portion of the barrel 35 above said disk with a thin coating of varnish-like sealing material 73 which will not fuse with the plastic material of the shell 32 but adheres thereto sufficiently to exclude moisture from the cartridge 12.

The threaded nipple 41 of the cartridge 12 has threads of the same pitch as the internal threads in the upper end of the tube 13 and is thus adapted to be screwed into the upper end of said tube to make a tight threaded fit with the latter, with the end of the nipple very close to or in contact with the outer end of the striker stop 18 (FIG. 2). When the cartridge 12 is thus mounted on the launcher 11 the axially mounted percussion cap 34 of the cartridge is aligned with and close to the upper end

of the hole 19 in the firing pin stop 18. Users of the signal device 11 are instructed to always have the firing pin 25 on safety position, that is with the cocking pin 28 in the notch 15 as shown in FIG. 2 before screwing a cartridge 12 into launcher 11 as above described and as shown in FIGS. 1 and 2, and preferably never to do this excepting immediately before and preparatory to the firing of a signal with the device 10. These precautions are of course to prevent the accidental discharge of the device resulting in injury to person or property.

Operation

The cartridge 12 having been screwed snugly into the launcher 11 as shown in FIG. 2, with the firing pin 25 on safety, the next step in the operation of the device 10 is to cock the firing pin as shown in FIG. 1. This is done by holding the device in the left hand, pointing the cartridge 12 away from the face and preferably upwardly, and then with the thumb of the right hand pulling the cocking pin 28 downwardly out of the notch 15 into the firing slot 14 and to the lower end of said slot and then rotating the firing pin 25 to swing the pin 28 into the cocking notch 16 where said pin is held fast by the upward pressure of the spring 30 against the striker 25 and the fact that the cocking notch 16 slants slightly upwardly from the longitudinal axis of the firing slot 14.

The device 10 is now held aloft vertically by gripping the lower portion of the launcher 11 in the right hand, with the right thumb to the right of the knurled cocking pin head 29, and the device is fired by using this thumb to shift the cocking pin 28 out of the cocking notch 16 and into the firing slot 14. This releases the firing pin 25 from restraint, coiled spring 30 thereupon rapidly impelling the firing pin upwardly to the full limit allowed by the firing slot 14 which terminates with striker 26 penetrating the percussion cap 34 of the cartridge 12.

This detonates the cap 34 which contains a sufficiently heavy charge of percussion powder to fill the pressure pocket 42 in the bottom of the firing chamber 43 with combustion gases under a pressure of approximately 2400 pounds per square inch. Flame produced in this explosion passes through the hole 71 in cardboard disk 70 and ignites the rocket-fuse powder charge in the projectile 33 in an area of the downwardly exposed surface of this charge approximately the same size as the hole 71. The precise limitation in the size and location of this area in which the charge 64 is ignited has a significant bearing on the operation of the device 10 as will be subsequently explained in detail.

Bearing upwardly against the inturned flange 63 of the projectile 33 and outwardly against the firing chamber 43 of the barrel 35, the disk 70 acts as a packer against the escape of the gases produced by the percussion cap 34 when this is detonated, except by the propulsion of the projectile 33 from the barrel 35. Although adequate for sealing purposes, the bond between the sealing film 73 and the cartridge barrel 35 is readily broken by the gas pressure tending to expel the projectile 33 from the cartridge. FIG. 3 shows the firing of the device with the projectile only partly out of the cartridge while FIG. 4 shows the projectile in free flight upwardly and indicates how this flight is aided by the rocket action of the restricted symmetrical burning of the rocket-fuse charge 64. The latter view also indicates the relative instability of the cardboard disks 70 and 72 so that the turbulence of the combustion gases propelling the projectile from the cartridge (and that of the surrounding atmosphere) deflects these disks to one side or the other of the axial path of the projectile so as not to interfere with the flight of the latter along this path.

The limitation by the disk 70 of the area in which the rocket-fuse charge 64 is ignited has two principal results of great benefit in the operation of the device 10. The regulated and symmetrical burning of the charge 64 during this period causes it to impart a substantial rocket thrust upwardly against the projectile 33 throughout the initial one-third of its upward flight which considerably offsets the air resistance impeding such travel so that the projectile reaches a much higher altitude than would otherwise be the case without this assistance. Retardation in the consumption of the two charges in the projectile 33 also slows up the loss of weight in the projectile and thus renders the momentum of the unconsumed portions of the charges more effective in offsetting the air resistance to the upward travel of the projectile. Finally, the delay in igniting the signal charge 60 due to the feature being discussed, renders the light produced by the burning of this charge much more effective because the projectile 33 is at a substantially higher altitude while this charge is burning.

The inturned flange 63 of the projectile 33 serves an important function in reinforcing the mouth of the cup 55 so as to resist splitting of the edge of the cup which this shell otherwise has a tendency to do, when fired, and which results in fragmentation and loss of burning particles of the charges in the projectile which are visible in the air and detract from the strength of the signal given. The inturned flange 63 also narrows the mouth of the projectile thereby retaining charges 60 and 64 in the cup 55 at least up to the time in the flight of the projectile when the flange 63 is consumed by the flame produced by the final burning out of the charge 64 and the coincidental ignition of the signal charge 60. From this point on (which starts about midway in the upward flight of the projectile 33) the material of the cup 55 burns at the exposed edge of this along with the material of the signal charge 60. At the conclusion of the burning of the charge 60, the entire cup 55 has been consumed and there is nothing left, even in the form of an ash, to fall to earth. This mode of operation of the projectile 33 is of great importance in eliminating fire hazards in the use of the invention and the very thin combustible sheet metal of which the cup 55 is formed accelerates the rate of combustion of the cup and gives assurance that the cup is completely consumed in the air.

While the composition above described of the material used in making the signal charge 60 in the projectile 33 is for the purpose of producing a red flare signal, other colors can be produced in such a flare by substituting other color producing chemicals for the strontium oxalate component of said composition. For instance, barium chlorate when so substituted would produce a flare with a green color. It is also to be understood that the signal charge 60 may be composed of chemicals adapted to produce a dense cloud of smoke in order to manufacture a cartridge 12 adapted for giving a smoke signal during the daytime.

While a specific embodiment of the invention has been illustrated in the drawings and above described for the purpose of disclosing the invention, it is to be understood that this is for illustrative purposes only and that various changes might be made in the specific form shown without departing from the spirit of the invention or the scope of the appended claims.

The claims are:

1. A protechnic signal producing cartridge comprising:
   A. a shell including:
      (1) a cylindrical thin-walled barrel enclosing a firing chamber;
         (*a*) said barrel being of adequate strength to withstand, without external support, the firing of said cartridge,
      (2) a base closing one end of said barrel
         (*a*) to form the breach of said chamber and present to said chamber a concave surface forming a gas expansion pocket at the inner end of said chamber
         (*b*) said base providing an axial threaded nipple having an axial bore therein communicating with said pocket,

(c) said bore having a counterbore in its outer end portion to provide a cap receptacle;

B. a percussion cap mounted in said receptacle;

C. a wadding disk slidably fitting within said chamber against the peripheral portion of said base,

(1) there being a small hole formed axially in said disk;

D. a signal projectile slidably fitting within said chamber against said disk, said projectile including:

(1) a thin-walled cylindrical cup, inverted in said chamber to present its mouth to said disk,

(2) a signal powder charge pressed into said cup to partially fill the same,

(3) and a fuse powder charge pressed into the mouth of said cup over said signal charge and approximately completing the filling of said cup with said charges; and

E. sealing means applied to the open end of said barrel and to said projectile to retain the latter in said barrel to exclude moisture from said barrel.

2. A combination as in claim 1 in which said sealing means comprises a cardboard disk slidably fitting within the open mouth of said chamber against said projectile; and a coating of plastic sealing material applied to the exposed face of said disk and the internal surface of said barrel exposed above said disk.

3. A protechnic signal producing cartridge as recited in claim 1 wherein the concave surface presented by said shell base to said firing chamber is frusto-conical with an altitude approximately equal to the radius of said firing chamber.

4. A pyrotechnic signal producing cartridge as recited in claim 1 wherein

(a) the shell thereof is jet-molded of a high tensile strength plastic,

(b) the counterbore in the shell nipple is substantially larger in diameter and depth than said percussion cap, and

(c) a metal reinforcing sleeve having an inturned annular flange at its inner end is provided, said sleeve being pressed into said counterbore, the latter receiving said sleeve with a pressed fit, to produce a receptacle for said percussion cap, said cap being mounted with a press fit in said sleeve, to rest against said flange.

5. A pyrotechnic signal producing cartridge as recited in claim 1 wherein said flare projectile cup is comprised of a relatively combustible metal selected from the group consisting of aluminum, magnesium, zinc, and die-casting metal.

6. A pyrotechnic signal producing cartridge as recited in claim 5 in which the flare projectile cup is provided at its mouth with an inturned flange to strengthen the mouth portion of said cup during the firing of said projectile and to confine the powder charges within said cup during the initial portion of the flight of said projectile.

7. A pyrotechnic rocket flare projectile which will be totally consumed when fired upwardly into the air, thereby practically eliminating incendiary hazards incidental to its use, said projectile comprising:

A. a thin-walled cylindrical cup with a thickness of approximately .005 inch, said cup being made of relatively highly combustible metal,

B. a flare powder charge pressed under high pressure into said cup to partially fill the latter and leave a deep, concave depression in said charge;

C. a fuse powder charge pressed into said cup to overlie said flare powder charge and fill the depression formed therein; and

D. a curled annular inturned lip on said cup for engaging said fuse charge and retaining said charge in said cup, said lip and cup being consumed upon the burning of said charges.

8. A pyrotechnic signal producing cartridge comprising:

A. a shell including:

(1) a cylindrical thin-walled barrel enclosing a chamber,

(a) said barrel being of adequate strength to withstand, without external support, the firing of said cartridge,

(2) a base closing one end of said barrel,

(a) to form the breech of said chamber and present to said chamber a concave surface forming a gas expansion pocket at the inner end of said chamber,

(b) said base providing an axial threaded nipple having an axial bore therein communicating with said pocket,

(c) said bore having a counterbore in its outer end portion to provide a cap receptacle;

B. a percussion cap mounted in said receptacle;

C. a signal projectile slidably fitting within said chamber, said projectile including:

(1) a thin-walled cylindrical cup made of a relatively higher combustible metal,

(2) a flare powder charge pressed under high pressure into said cup to partially fill the latter,

(3) and a fuse powder charge pressed into the mouth of said cup over said flare powder charge and approximately completing the filling of said cup; and

D. sealing means applied to the open end of said barrel and to said projectile to retain the latter in said barrel to exclude moisture from said barrel.

9. A pyrotechnic rocket flare projectile which will be totally consumed when fired upwardly into the air, thereby practically eliminating incendiary hazards incidental to its use, said projectile comprising:

A. a thin-walled cylindrical cup made of a relatively highly combustible metal,

B. a flare powder charge comprising:

(a) magnesium powder of approximately 200 mesh, 70% by weight,

(b) potassium perchlorate, 20% by weight,

(c) a color producing additive, 4% by weight, selected from the group consisting of strontium oxalate and barium chlorate, and

(d) gum arabic, 1% by weight; and

C. a fuse powder charge pressed into said cup to overlie said flare powder charge and fill the depression formed therein, said fuse powder charge comprising:

(a) magnesium powder of approximately 200 mesh, 25% by weight,

(b) blasting powder, 50% by weight,

(c) powdered charcoal, 24% by weight, and

(d) gum arabic, 1% by weight.

References Cited in the file of this patent

UNITED STATES PATENTS

1,947,834	Driggs et al.	Feb. 20, 1934
2,319,248	Meek	May 18, 1943
2,418,333	Caldwell et al.	Apr. 1, 1947
2,459,687	Decker	Jan. 18, 1949
2,791,178	Thompson	May 7, 1957
2,868,129	Johnson et al.	Jan. 13, 1959
2,986,999	Fiedler et al.	June 6, 1961
2,995,526	De Ment	Aug. 8, 1961

FOREIGN PATENTS

560,344	Great Britain	Mar. 31, 1944

OTHER REFERENCES

Military Explosives, TM 9-1910, Dept. of Army Technical Manual. April 1955, pages 284-288. (Copy in Div. 46 and Library.)

Sept. 3, 1963 R. O. STEFAN ET AL 3,102,477

ROCKET SIGNAL DEVICE

Filed Nov. 21, 1961

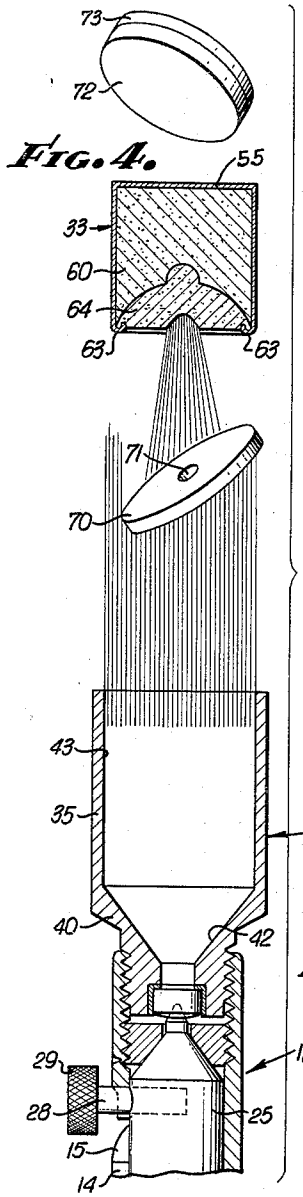

FIG. 4.

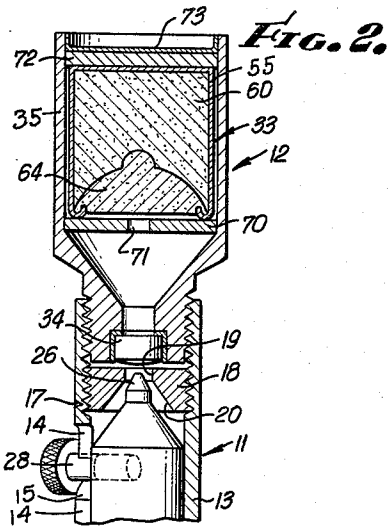

FIG. 2.

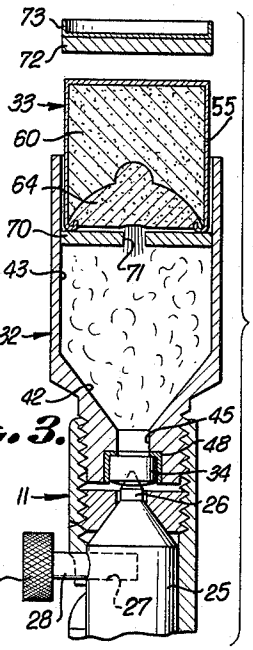

FIG. 3.

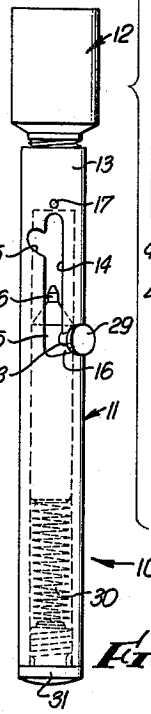

FIG. 1.

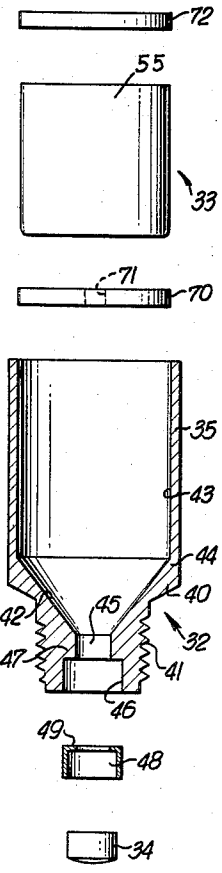

FIG. 5.

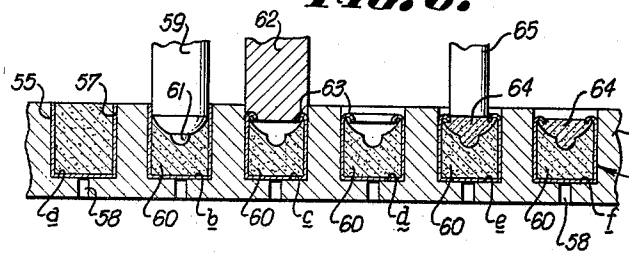

FIG. 6.

RUSSELL O. STEFAN
ANTON G. LANG
INVENTORS.

BY

ATTORNEY.