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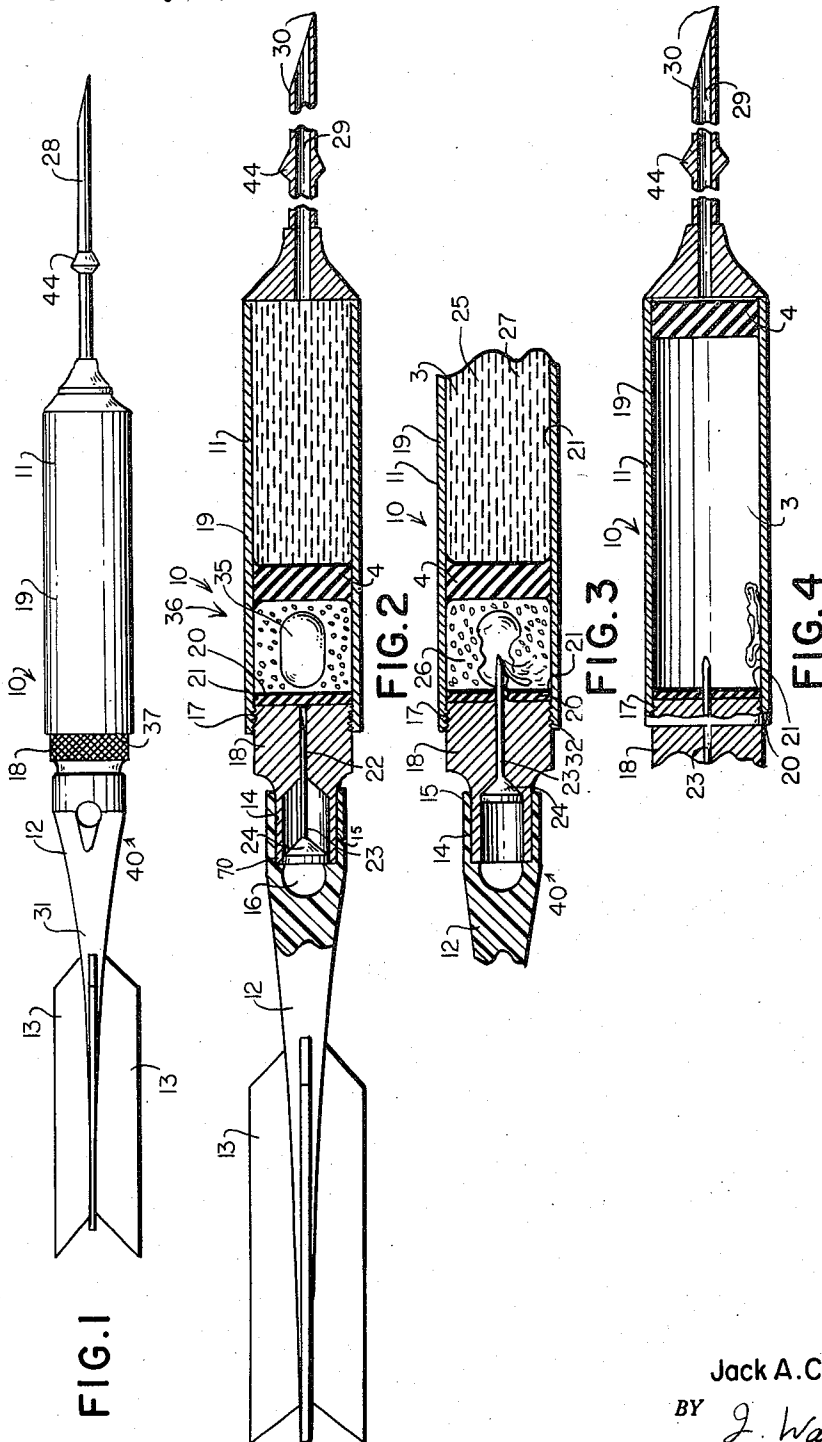
J. A. CROCKFORD ET AL

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PROJECTILE FOR DELIVERY OF DRUGS TO ANIMALS

Filed July 23, 1957

2 Sheets-Sheet 1



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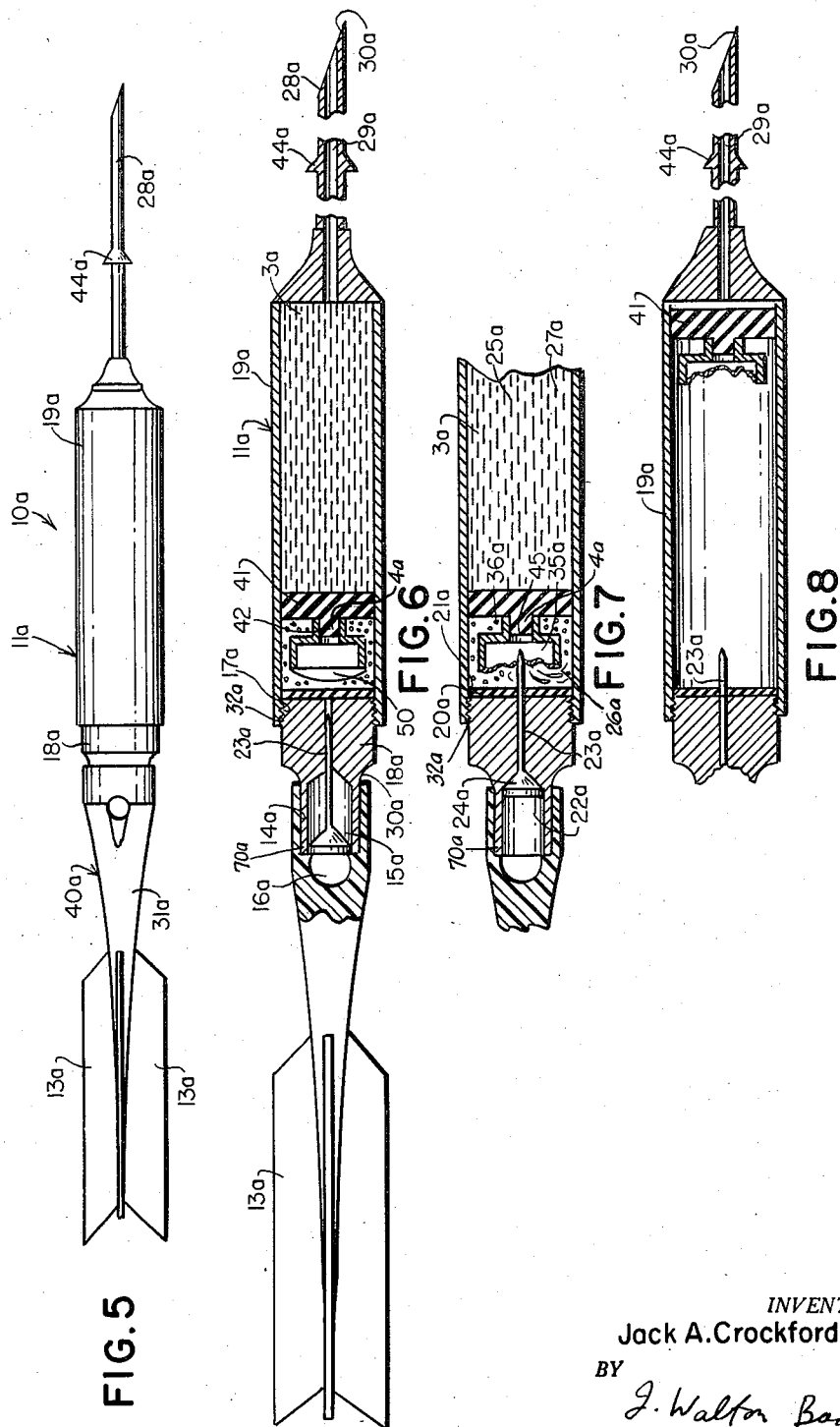
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PROJECTILE FOR DELIVERY OF DRUGS TO ANIMALS

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10 Claims. (Cl. 102—92)

This invention relates to a projectile for the delivery of drugs to animals of novel construction. The instant application relates to constructions of the projectile itself. The method of using the said projectile in various applications is claimed in a co-pending application Serial Number 677,141 filed August 8, 1957. To the extent, therefore, that the disclosure of this application shows such method, it is not to be considered a disclaimer of the subject matter involved although not claimed in the instant application.

For a considerable period of time work has been carried on toward the construction of a projectile which could be fired at an animal from a distance and which would inject a liquid drug into the animal after the projectile would penetrate the animal's body. It is obvious that such projectile would have great advantages in permitting injection of immunizing drugs, serums, antibiotics, immobilizing drug compositions, or similar materials without causing the danger of injury to the injector because of the animal's resistance to the injection.

Various projectile constructions have been heretofore made which have claimed to have accomplished the above objects but all of the prior constructions have been unsatisfactory in that they have not been positive in operation. While they would operate under optimum and laboratory conditions, they were completely unsatisfactory in the field. Indeed, as set forth in applications heretofore filed, because of the fact that a successful projectile of the type described in this invention was not available, we were forced to make a projectile for our purposes which used solid-type drugs thereupon despite the fact that the liquid forms of the drug were more effective for our purposes.

In the light of our research experiences we now know that the failure of the prior projectiles has been due to the fact that the injection mechanism therein has been triggered by the impact of the unit upon the body of the animal. But impact forces are not uniform nor is the direction of impact ever the same. However triggering mechanism of this type is dependent upon the impact force and direction of impact. Thus, if these forces are not as calculated under optimum conditions the injection mechanism will not trigger and the device will be inoperative.

The only point at which the forces actuating a triggering mechanism are always constant both in value and direction are at the instant when the projectile is fired from the gun. But if the injection mechanism is triggered at this point it would seem that the drug would be expelled from the projectile before the projectile penetrates the body of the animal. Should delay devices be provided in the projectile it would seem that these would again require impact triggering.

However the description of this invention will show how we have met the problems involved and have produced a projectile which functions positively and effectively.

Two preferred constructions of the projectile of this

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invention, which represent the best modes presently known to applicants for constructing the same, are set forth in this specification and described in detail. However such detailed descriptions of specific constructions of this invention are not to be construed as limitations thereof. Various changes and modifications of the specific constructions shown could obviously be made within the spirit and scope of this invention and would occur to those skilled in this art. The scope of this invention is to be determined solely by the scope of the appended claims.

The specific constructions shown will now be discussed in detail by reference to the drawings herein which are made a part of this specification.

Fig. 1 is a side perspective view of one form of projectile made in accordance with this invention.

Fig. 2 is a side view, of a construction similar to that of Fig. 1, but with the body portion thereof shown in section so as to show the internal construction of parts.

Fig. 3 is a side detail view, in section, of the rear of the body portion of the projectile shown in Figs. 1 and 2, showing the means of triggering the injection mechanism upon firing of the projectile.

Fig. 4 is a side detail view, in section, similar to that of Fig. 3, showing the manner in which the drug is expelled from the projectile after triggering of the injection mechanism.

Fig. 5 is a side perspective view, similar to that shown in Fig. 1, of an alternative form of projectile made in accordance with this invention.

Fig. 6 is a side view of a construction similar to that of Fig. 5, but with the body portion thereof shown in section so as to illustrate the internal construction.

Fig. 7 is a side detail view, in section, showing the means of triggering the injection mechanism shown upon firing of the projectile.

Fig. 8 is a side detail view, in section, similar to Fig. 7, showing the manner in which the drug is expelled from the projectile after triggering of the injection mechanism.

The form of the invention shown in Figs. 1-4 will now be referred to for a detailed description of its construction and operation. After the construction shown in Figs. 1-4 is discussed in detail the alternative construction shown in Figs. 5-8 will be described and then the operation of the invention will be set forth.

First referring to Figs. 1-4 the projectile 10 is formed with a body portion 11. Body portion 11 is in turn divided into a main portion 19 and a cap portion 18. Cap portion 18 is narrowed at its rear portion 70.

A tail portion 40 is provided which is formed with stabilizing fins 13 secured to a shaft 31. The forward end of shaft 31 is provided with an opening 14 so that tail portion 40 can fit over the rear portion 15 of cap 18.

Opening 14, however, extends rearwardly for a greater distance than would be necessary for fitting over the rear 15 of cap 18 so that an additional opening 16 is provided. Opening 16 permits the entrance of gas therein after firing to trigger the injection mechanism as will be subsequently explained.

Main body portion 19 bears female threads 17 at its rear portion and cap 18 bears mating male threads 32 at its forward end portion. A seal 20 of resilient material such as rubber, vinyl resin, or the like is disposed at the forward end portion of cap 18 and abuts against the inner wall 21 of main body portion 19.

Cap 18 is formed with a recess 22 therein which is larger at its rear portion than at its forward portion. A forwardly movable pointed needle 23 having a flared tail portion 24 is disposed within recess 22.

Main body portion 19 is hollow and contains an interior cavity 3. A movable propelling member 4 is disposed within cavity 3 and abuts against its inner wall 21.

Propelling member 4 divides cavity 3 into a front drug carrying chamber 25 and a rear reaction chamber 26. A liquid drug 27 is disposed within drug carrying chamber 25.

A needle 28 is secured to the head of projectile 10 and is formed with channel 29 and point 30. Channel 29 communicates with drug carrying chamber 25. A barb 44, to hold needle 28 in place during injection, is disposed upon needle 28.

A puncturable container 35, made of rubber, vinyl, or similar resilient material is filled with a liquid gas-producing reactant. The liquid gas-producing reactant is preferably under pressure within container 35.

Adjacent to container 35 and also within reaction chamber 26 is a solid gas producing reactant 36. It is pointed out that the use of the terms "liquid gas-producing reactant" and "solid gas-producing reactant" in this specification and claims is not limited to a single compound. Such reactants may conceivably be formed of more than one compound. In other words the "solid gas-producing reactant" could be a mixture of citric acid and sodium carbonate while the "liquid gas-producing reactant" could be a solution of such compounds in water, a mixture of water and hydrogen peroxide, or the like.

Cap 18, in order to facilitate assembly of the device, can be formed with a knurled outer face 37.

The alternative form of the invention shown in Figs. 5-8 is substantially similar, in most respects, to the form of the invention shown in Figs. 1-4.

The projectile of this modification 10a is formed with a body portion 11a. Body portion 11a is in turn divided into a main portion 19a and a cap portion 18a. Cap portion 18a is narrowed at its rear portion 70a.

A tail portion 40a is provided which is formed with stabilizing fins 13a secured to a shaft 31a. The forward end of shaft 31a is provided with an opening 14a so that tail portion 40a can fit over the rear portion 15a of cap 18a.

Opening 14a, as in the form of the invention shown in Figs. 1-4, extends rearwardly for a greater distance than would be necessary for fitting over the rear 15a of cap 18a so that an additional space or opening 16a is provided. Space 16a permits the entrance of gas therein after firing to trigger the injection mechanism of the projectile.

Main body portion 19a bears female threads 17a at its rear portion and cap 18a bears mating male threads 32a at its forward end portion. A seal 20a of resilient material is disposed at the forward end portion of cap 18a and abuts against the inner wall 21a of main body portion 19a.

Cap 18a is formed with a recess 22a therein which is larger at its rear portion than at its forward portion. A forwardly movable needle 23a having a flared tail portion 24a is disposed within recess 22a.

Main body portion 19a is hollow and contains an interior cavity 3a. A movable propelling member 4a, formed in the shape of a T, is disposed within cavity 3a. The bar portion 41 of the T abuts against the inner wall 21a of cavity 3a, while the shaft 42 of the T is pointed rearwardly.

The portion 41 of propelling member 4a divides cavity 3a into a front drug carrying chamber 25a and a rear reaction chamber 26a. A liquid drug 27a is disposed within drug carrying chamber 25a.

A needle 28a is secured to the head of projectile 10a and is formed with a channel 29a and a point 30a. A barb 44a, adapted to hold needle 28a in place during injection, is disposed upon needle 28a.

A puncturable container 35a, made of rubber, vinyl, or similar resilient material, is formed with an opening 45 therein smaller in size than the shaft 42 of the propelling member 24a. Container 35a is disposed within reaction chamber 26a. A liquid gas-producing reactant is placed within container 35a up to its full capacity.

Shaft 42 is then inserted into opening 45 so as to compress the liquid and to cause a bulge in the rear face 50 of container 35a.

Adjacent to container 35a and also within reaction chamber 26a is a solid gas-producing reactant 36a.

With the description set forth above the operation of this invention will be explained by reference to the form of the invention shown in Figs. 1-4. Where the form of the invention shown in Figs. 5-8 varies the operative differences in steps in the operation of this form from the principal form will be obvious.

The projectile is loaded for action by removing cap 18 from main body portion 19 by unscrewing the parts. The quantity of liquid drug desired is then placed within cavity 3 by means of injection with a hypodermic needle or similar instrument.

Propelling member 4 is then inserted into the rear of body portion 19 and moved forwardly by being pushed by a blunt probe or similar instrument. While the position that propelling member 4 assumes within cavity 3 is not critical it is preferable to place propelling member 4 at the lowest possible point. This point can be determined by pushing propelling member 4 downwardly until liquid appears at the point 30 of needle 28.

A quantity of solid gas-producing reactant is then placed within the reaction chamber 26 produced in cavity 3 by the positioning of propelling member 4. The reactant used is not critical and any suitable gas-producing reactant can be used. As examples of possible reactants mention is made of calcium carbide, manganese dioxide, citric acid and sodium carbonate in combination, sodium peroxide, oxalic acid and sodium bi-carbonate in combination, etc.

A liquid gas-producing reactant is then placed within a container 35 which is disposed adjacently to the solid gas-producing reactant within reaction chamber 26. The container as shown in the drawings can be loaded for operation by taking a small cylindrical rubber balloon such as seen in a child's toy box and which has a uniform diameter of about $\frac{1}{8}$ ". The liquid is placed within the balloon and the balloon tied below the upper level of the water so that compression occurs. The portion of the balloon above the tie is then cut off.

In this connection it is pointed out that the alternative form of the invention shown in Figs. 5-8 illustrates an easier method of loading container 35a.

The liquid used to load container 35 will depend upon the nature of the solid gas-producing reactant employed. Assuming the reactants as set forth above are used then the liquid reactants used would be water, hydrogen peroxide, and water.

Also, in this connection, it is pointed out that it would also be possible to use two separate liquid reactants if the surface conditions with regard thereto would be satisfactory (that is, they would not mix too readily) or very severe temperature conditions would be encountered.

The position of container 35 within reaction chamber 26 is in registration with the point of needle 23 when such needle is propelled forwardly as will be subsequently set forth.

After the gas-producing reactants are placed within reaction chamber 26 cap 18 is screwed into place upon main body portion 19 and the projectile loaded into a gun, preferably an air rifle. The firing of the gun causes a blast of gas to impinge upon flared portion 24 of needle 23 causing needle 23 to move forwardly and pierce seal 20. This piercing can be facilitated by making seal 20 deliberately thin at the point of impact.

The piercing of seal 20 and the forward movement of needle 23 also punctures container 35 and thus causes the reactants to intermix and to commence producing a gas. However, while this is occurring the projectile is also being propelled toward the animal. Since sufficient gas pressure is not immediately produced no effect is produced on the drug within the projectile until a discrete

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interval of time is passed. Thereafter the pressure of the gas moves propelling member 4 forwardly and thus expels the drug from the projectile through needle 28 by means of the channel 29 provided therein. The needle is protected against withdrawal from the animal while the drug is being injected by the use of barb 44 which retains needle 28 in place within the animal. However this retention of the needle is not permanent and the normal healing processes of the animal will in time expel the projectile from its body.

The required delay in causing the drug to be expelled from the projectile after triggering of the mechanism to permit the projectile to penetrate the body of the animal is primarily controlled by the particle size of the solid gas-producing reactant used. The larger the particle size employed the slower will be the production of gas and the greater will be the delay. Under normal conditions we prefer to use solid gas-producing reactants of the particle size of large barley (uncooked). Where low temperatures are to be encountered we use particle sizes ranging from small barley to powdered (not granulated sugar). Under extremely low temperature conditions where water will normally freeze we can use such reactants as glacial acetic acid and ammonium sulphide.

In determining the particle size we prefer to use the larger size rather than the smaller at given temperature values. If the reaction is too slow the projectile will still reach the animal before the drug is expelled. The only untoward effect of using too slow a reaction speed will be to delay the action of the drug. However, if the reaction is too rapid then the drug will be expelled from the projectile before reaching the animal and the effect desired will not take place.

The quantity of reactants used is not critical except that at least sufficient reactants should be used to cause the generation of sufficient gas to propel the propelling member forwardly and expel the drug from the projectile. Here again an excess of reactants does not harm but an insufficient quantity will not produce the desired effect.

The body of the projectile is preferably made of metal but molded plastic will also be satisfactory as well as any other suitable material. The propelling member, seal, and container for the liquid gas-producing reactant are preferably made of rubber or resilient plastic such as vinyl resin. The tail portion is preferably made of molded plastic. The needles are preferably made of tempered metal such as steel.

However, with respect to materials used, these are not critical and any materials which have the necessary characteristics can also be employed.

We claim:

1. A projectile comprising a hollow body portion, a tail portion, and a drug injecting head portion communicating with said body portion, a propelling member within said body portion, and means actuated by firing of said projectile for causing a plurality of gas-producing reactants to intermix upon firing of said projectile so as to move said propelling member forwardly and thus drive said drug out of said body portion after a discrete interval of time.

2. A projectile comprising a body portion having a drug containing cavity therewithin, a tail portion, and a drug injecting head portion communicating with and operatively connected to said drug containing cavity, a propelling member movable within said drug containing cavity, and means actuated by firing of said projectile for causing a plurality of gas-producing reactants to intermix upon firing of said projectile so as to produce a gas pressure upon said propelling member and to drive it forwardly after a discrete interval of time so as to drive said drug out of said body portion.

3. A projectile for injection of liquid drugs into animals comprising a hollow body portion, a tail portion secured to said body portion, a movable propelling mem-

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ber within said body portion dividing the same into a front drug carrying chamber and a rear reaction chamber, a hollow needle at the head of said body portion communicating with said drug carrying chamber, a puncturable seal member behind said reaction chamber, a puncturable container holding a liquid gas-producing reactant within said reaction chamber in operative relationship with and behind said propelling member, an additional gas-producing reactant in solid form adjacent to said container and within said reaction chamber, and means actuated by firing of said projectile for puncturing said seal and said container upon firing of said projectile so that said gas-producing reactants intermix and produce a gas which drives said propelling member forwardly after a discrete period of time and thus injects said drug into the animal.

4. A projectile for the injection of liquid drugs into animals comprising a hollow body portion, a tail portion secured to said body portion, a movable propelling member within said body portion dividing the same into a front drug carrying chamber and a rear reaction chamber, a hollow needle at the head of said body portion communicating with said drug carrying chamber, a puncturable container holding a liquid gas-producing reactant within said reaction chamber in operative relationship with and behind said propelling member, an additional gas producing reactant in operative relationship with and adjacent to said container, and means actuated by firing of said projectile for puncturing said container upon firing of said projectile so that said gas-producing reactants intermix and produce a gas which drives said spacer member forwardly after a discrete interval of time and thus injects said drug into the animal.

5. A projectile for injection of liquid drugs into animals comprising a hollow body portion, a tail portion secured to said body portion, a movable propelling member within said body portion dividing the same into a front drug carrying chamber and a rear reaction chamber, a hollow needle at the head of said body portion communicating with said drug carrying chamber, a puncturable container holding a liquid gas-producing reactant within said reaction chamber in operative relationship with and behind said propelling member, an additional gas-producing reactant in solid granular form adjacent to said container and within said reaction chamber, and means actuated by firing of said projectile for puncturing said container upon firing of said projectile so that said gas-producing reactants intermix and produce a gas which drives said propelling member forwardly after a discrete period of time and thus injects the drug into the animal.

6. A projectile for injection of liquid drugs into animals comprising a hollow body portion, a stabilizing fin secured to the tail end of said body portion, a forwardly movable propelling member within said body portion dividing the same into a front drug carrying chamber and a rear reaction chamber, a first hollow needle at the head end of said body portion communicating with said drug carrying chamber, a puncturable seal member behind said reaction chamber, a puncturable container holding a liquid gas-producing reactant within said reaction chamber in operative relationship with and behind said propelling member, an additional gas-producing reactant in solid granular form adjacent to said container and within said reaction chamber, a second forwardly movable pointed needle having a flared tail portion behind said seal member and in registration with said puncturable container, wherein said second needle is actuated and driven forwardly upon firing of said projectile so as to puncture said seal and said container so that said gas-producing reactants produce a gas which drives said propelling member forwardly after a discrete period of time and thus injects said drug into the animal.

7. A projectile for injection of liquid drugs into animals comprising a hollow body portion, a stabilizing fin secured to the tail end of said body portion, a forwardly

movable propelling member within said body portion dividing the same into a front drug carrying chamber and a rear reaction chamber, a first hollow needle at the head end of said body portion communicating with said drug carrying chamber, a projecting barb member upon said first needle, a puncturable seal of resilient material behind said reaction chamber, a puncturable container holding a liquid gas-producing reactant within said reaction chamber in operative relationship with and behind said propelling member, an additional gas-producing reactant in solid form adjacent to said container and within said reaction chamber, a second forwardly movable pointed needle having a flared tail portion behind said seal member and in registration with said puncturable container, wherein said second needle is actuated and driven forwardly upon firing of said projectile so as to puncture said seal and said container so that said gas-producing reactants produce a gas which drives said propelling member forwardly after a discrete period of time and thus injects said drug into said animal.

8. A projectile for injection of liquid drugs into animals comprising a hollow body portion, a stabilizing fin secured to the tail end of said body portion, a movable propelling member within said body portion dividing the interior of the same into a front drug carrying chamber and a rear reaction chamber, a first hollow needle at the head end of said body portion communicating with said drug carrying chamber, a puncturable seal member of resilient material behind said reaction chamber, a puncturable container holding a liquid gas producing reactant within said reaction chamber in operative relationship with and behind said propelling member, an additional gas-producing reactant in solid form adjacent to said container and within said reaction chamber, a second forwardly movable needle behind said seal member and in registration with said puncturable container, wherein said second needle is actuated and driven forwardly upon firing said projectile so as to puncture said seal and said container so that said gas-producing reactants intermix and produce a gas which drives said propelling member forwardly after a discrete period of time and thus injects said drug into said animal.

9. A projectile for injection of liquid drugs into animals comprising a body portion formed with a drug containing cavity therewithin, a tail portion secured to said body portion, an injection member at the head of said body portion having drug conducting means thereupon

communicating with said drug containing cavity, a movable propelling member within said body portion behind said drug containing cavity and movable therewithin, a puncturable container holding a liquid gas-producing reactant in operative relationship with and behind said propelling member, an additional gas-producing reactant adjacent to said container within said body portion, and means actuated by firing of said projectile for puncturing said container upon firing of said projectile so that said gas-producing reactants intermix to produce a gas which drives said propelling member forwardly after a discrete period of time and thus injects said drug into said animal.

10. A projectile for injection of liquid drugs into animals comprising a hollow body portion, a stabilizing fin secured to the tail end of said body portion, a forwardly movable propelling member within said body portion formed in the shape of a T with the stem thereof pointing rearwardly, said propelling member dividing the interior of said body portion into a front drug carrying chamber and a rear reaction chamber; a first hollow needle at the head end of said body portion communicating with said drug carrying chamber, a projecting barb member upon said first needle, a puncturable seal of resilient material behind said reaction chamber, a puncturable container having an extensible rear portion and a front opening adapted to fit about the stem of the T of said propelling member and holding a liquid gas-propelling reactant within said reaction chamber, an additional gas-producing reactant in solid granular form adjacent to said container and within said reaction chamber, a second forwardly movable pointed needle having a flared tail portion behind said seal member and in registration with said puncturable container, wherein said second needle is actuated and driven forwardly upon firing of said projectile so as to puncture said seal and said container to produce a gas which drives said propelling member forwardly within said body member after a discrete period of time and thus injects said drug into the animal.

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