INJECTOR~~SYRINGE~~

TECHNICAL FIELD

[0001] The present invention relates to a syringe (injector) with which an injection objective substance is injected into an injection target area of a living body without using any injection needle.

BACKGROUND ART

[0002] In relation to a needle-free syringe (needleless syringe) with which the injection is performed without using any injection needle, a construction is adopted in some cases such that an injection component is injected or allowed to inject by applying a pressure to an accommodating chamber in which an injection solution is accommodated, by means of a pressurized gas or a spring. However, in the case of the needle-free syringe having the conventionally known construction, the reproducibility is unsatisfactory in relation to the depth and the injection amount of the injection solution. Therefore, it is difficult to affirm that such a needle-free syringe generally comes into widespread use.

[0003] Accordingly, such a technique is disclosed that a propellant charge, which is composed of a mixture of two types of powders, i.e., a high speed combustion powder and

Non-Patent Document 2: Joy Schramm-Baxter, Samir Mitragotri, "Needle-free jet injections: dependence of jet penetration and dispersion in the skin on jet power", Journal of Controlled Release (U.S.A.) 97 (2004), p527-535.

SUMMARY ~~OF THE INVENTION~~

Problem to Be Solved ~~by the Invention~~:

[0010] When the injection is performed for the living body, the component which is contained in the injection solution and the depth in the injection target area of the living body into which the component is to be fed differ depending on the purpose of the injection. This is because the injection target area of the living body includes various structures such as skin, muscle, internal organs and the like, and the biological tissues, which constitute the structures, have different functions depending on the depths from the surface (surface on which the syringe is brought in contact with the structure when the injection is performed), and because it becomes difficult to appropriately exhibit the effect if the component contained in the injection solution does not arrive at the objective biological tissue.

[0011] For example, the human skin can be distinguished or classified into epidermis, dermis, and subcutaneous tissue (hypodermis) in a layered form from the surface side. Further, the epidermis can be distinguished or

to contemplate the appropriate diffusion thereof. In particular, at the initial stage of the injection of the injection solution, it is necessary that the injection solution should be allowed to penetrate through the surface of the injection target area of the living body to form a state which is favorable for the injection solution to be diffused into the interior thereof (hereinafter referred to as "diffusion preparatory state" as well). Therefore, it is considered that the pressure control, which is performed at the initial stage of the injection, is extremely important. Taking the foregoing problem into consideration, an object of the present embodiments disclosed herein~~invention~~ is to provide a syringe which makes it possible to feed an injection objective substance into an objective injection target area of a living body without using any injection needle so that the injection objective substance can be widely diffused at a depth.

Solution for the Problem:

[0013] In order to solve the problem as described above, the present disclosure~~invention~~ adopts the following construction. That is, the pressure source of the pressurizing force to be exerted on an injection objective substance is an ignition charge having specified components and a gas generating agent, and the pressure transition brought about by the ignition charge is made steep as far as possible, in relation to a syringe for injecting the injection objective

substance into an injection target area of a living body without using any injection needle. Owing to the adoption of the ignition charge and the gas generating agent and the adoption of the pressure transition of the ignition charge, the injection objective substance can be fed into a biological tissue at a wide range of depths including relatively shallow depths in the injection target area.

[0014] In one aspect~~Specifically~~, there ~~present invention~~ is provide~~s~~d a syringe for injecting an injection objective substance into an injection target area of a living body without using any injection needle, ~~,~~ the syringe comprising:~~including~~ an ignition device which includes an ignition charge containing a fuel component and an oxidizing agent component; a combustion chamber into which a combustion product produced by a reaction of the fuel component and the oxidizing agent component during combustion of the ignition charge is allowed to flow and which accommodates a gas generating agent that is combustible by the combustion product to generate a predetermined gas; an enclosing unit which encloses the injection objective substance; a pressurizing unit which is constructed to pressurize the injection objective substance enclosed in the enclosing unit by means of a pressure in the combustion chamber; and a flow passage unit which defines a flow passage so that the injection objective substance, which is pressurized by the pressurizing unit, is allowed to inject to the injection target area of the living body, wherein:~~. Further,~~ the fuel

component and the oxidizing agent component contained in the ignition charge are determined so that any component, which behaves as a gas, is excluded from the combustion product when the combustion product is at ordinary temperature in the case where the fuel component and the oxidizing agent component are mixed at a stoichiometric ratio and combusted; and a cooling member is arranged in the combustion chamber so that the cooling member can be brought in contact with the combustion product produced by the combustion of the ignition charge to cool the combustion product.

[0015] In the syringe according to the present disclosure~~invention~~, the injection objective substance, which is to be injected into the injection target area of the living body, is enclosed in the enclosing unit, and the pressure is applied to the injection objective substance enclosed in the enclosing unit. Thus, the movement of the injection objective substance is prompted. As a result, the injection objective substance is allowed to discharge to the injection target area while passing through the flow passage unit. The injection objective substance contains a component or ingredient which is expected to exhibit any efficacy at the inside of the injection target area. In this context, the syringe according to the present disclosure~~invention~~ is constructed such that the enclosed injection objective substance is pressurized by the pressure which is brought about in the combustion chamber by the combustion