United States Patent

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[54] **INOCULATOR GUN WITH DELAYED ACTION**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **128/173**
[51] **Int. Cl.** **A61m 11/06**
[50] **Field of Search** 128/173H; 124/11; 43/6.19

[56] **References Cited**

UNITED STATES PATENTS

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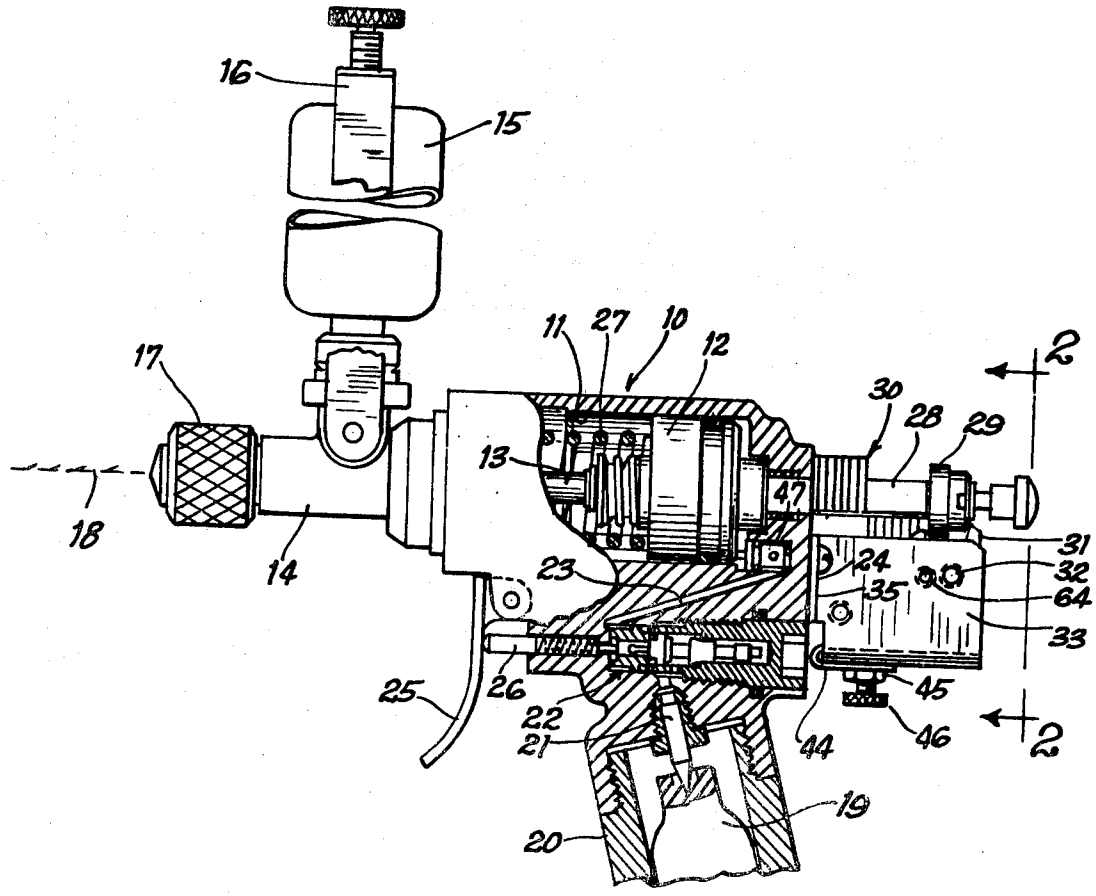
ABSTRACT: An improvement in gas-operated inoculator guns which ensures correct operating pressure for the gun and hence a correct penetrating pressure for the inoculant. The pressure-producing piston is held back by a spring-pressed latch which is released by a plunger operated by the pressure of the gas behind the piston. The spring pressure is adjustable so that the gas pressure at which the piston is released can thereby be varied. This in turn makes it possible to adjust the pressure at which the inoculant is introduced under the skin. The latch prevents operation of the gun when insufficient pressure is available for a satisfactory inoculation.



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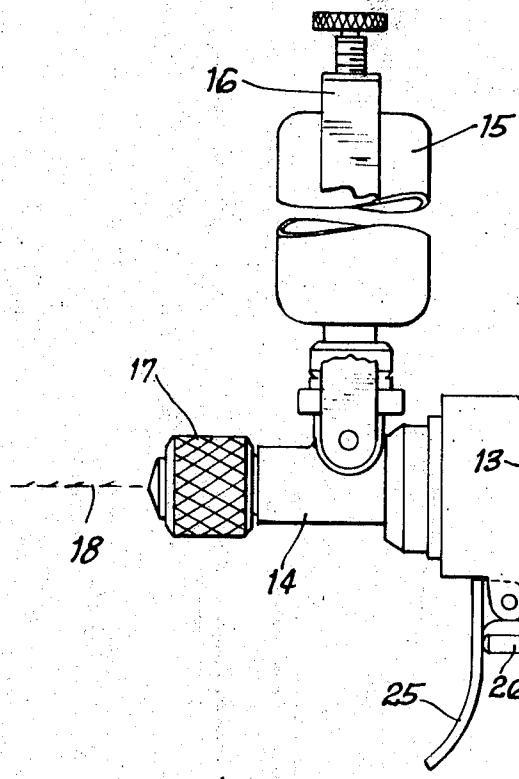
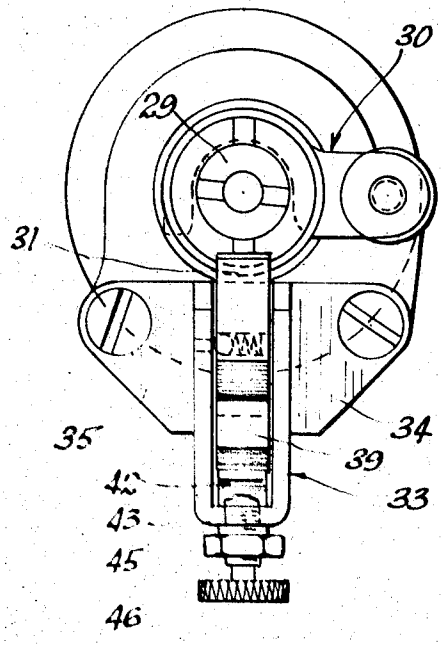


FIG. 1

FIG. 2



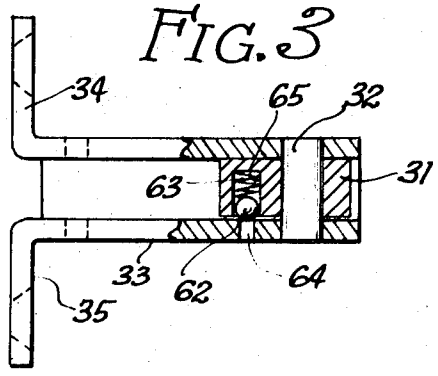


FIG. 3

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FIG. 4

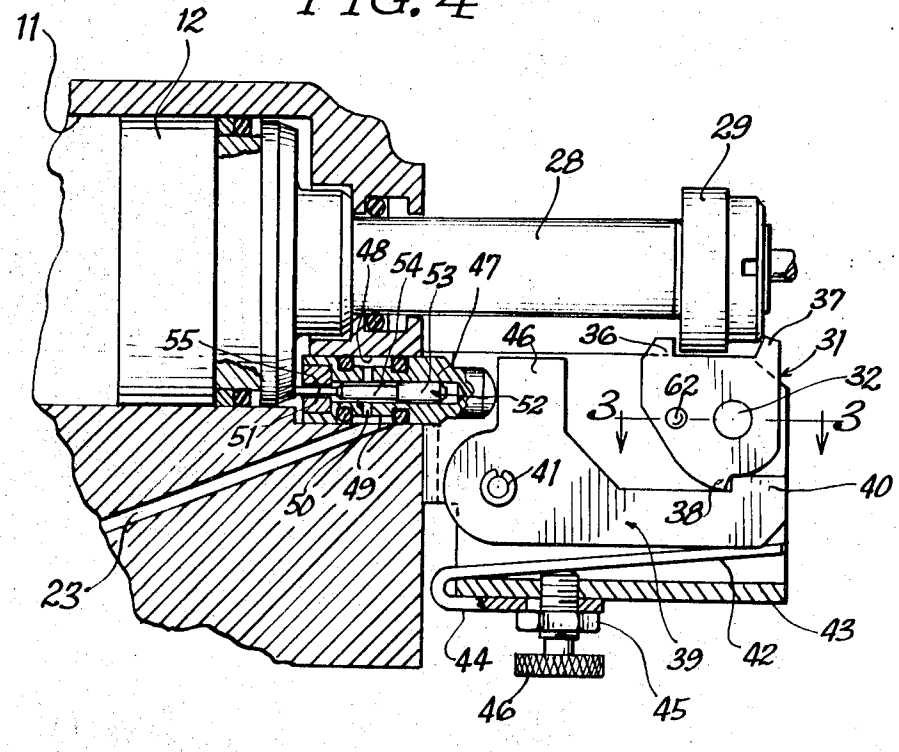


FIG. 5

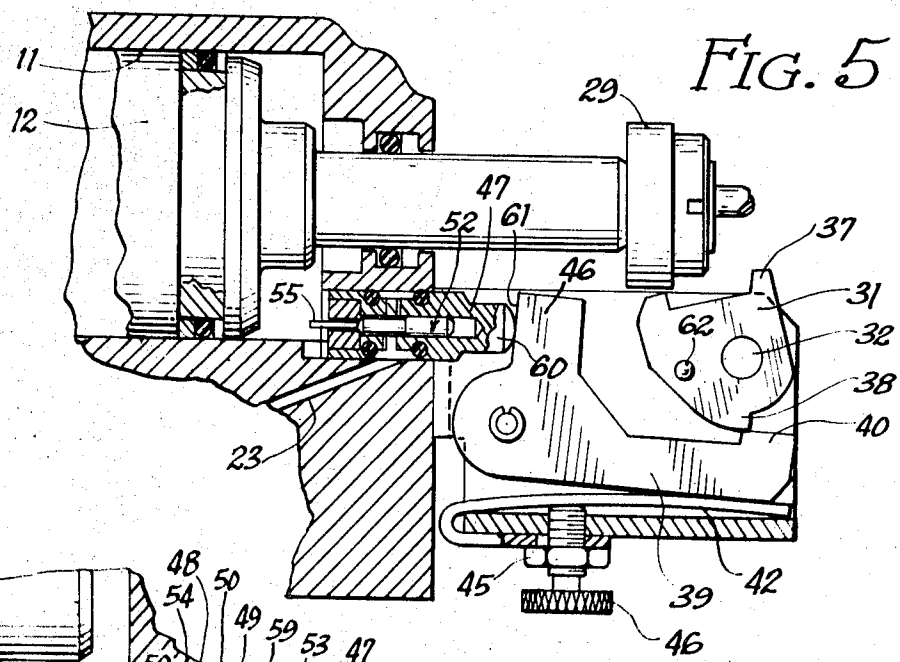
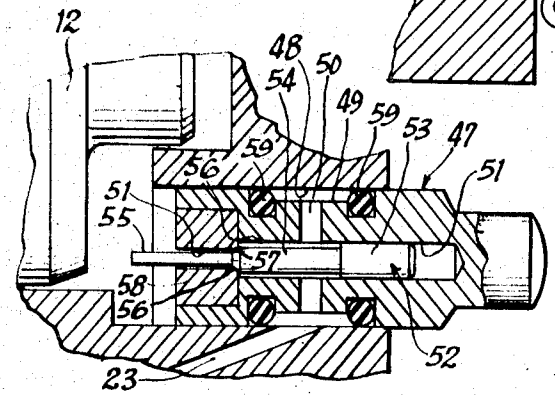


FIG. 6



INOCULATOR GUN WITH DELAYED ACTION

This invention relates to gas-operated inoculator guns designed to replace the hypodermic needle for injecting an inoculant under the skin of a patient.

In my prior U.S. Pat. No. 3,292,622 granted Dec. 20, 1966, for "Power Operated Inoculator," there is disclosed an inoculator gun having a fluid-operated piston which is connected to the rod of a smaller piston forming part of an inoculant pump. The latter has a small orifice through which the inoculant is ejected. The fluid for operating the piston is preferably CO_2 gas which is supplied from a bottle of appropriate size for the anticipated frequency of use of the gun. For occasional use, the bottle may be of a readily available 8.5 gram size and can be carried in the handle of the gun. In such small sizes, however, it has been found that the number of inoculations per bottle is lower than expected, and furthermore, the pressure imparted to the inoculant may not be sufficient to provide a satisfactory inoculation.

The principal object of this invention is to provide an improved gas-operated inoculator gun wherein correct operating pressure of the gun, particularly of the inoculant, is always assured.

Another object of this invention is to provide an improved gas-operated inoculator gun by which a greater number of inoculations for the same quantity of gas is achieved.

A further object of this invention is the prevention of the operation of a gas-operated inoculator gun when the pressure of the gas is insufficient to produce a satisfactory inoculation.

A still further object of this invention is the provision of a gas-operated inoculator gun wherein the pressure at which the inoculant is ejected can be varied to suit the skin of the patient.

These and other objects of this invention will become apparent from the following detailed description of a preferred embodiment thereof when taken together with the accompanying drawings in which

FIG. 1 is a fragmentary side elevation, partly in section, of a gas-operated inoculator gun incorporating this invention;

FIG. 2 is an enlarged end elevation of a portion of the gun of FIG. 1 looking in the direction of the arrows 2–2 thereof;

FIG. 3 is a plan view, partly in section, of a portion of the gun mechanism, looking in the direction of the arrows 3–3 of FIG. 4;

FIG. 4 is an enlarged fragmentary side elevation in section of the gun of FIG. 1 showing the mechanism of this invention as it appears before the gun is operated;

FIG. 5 is the same enlarged fragmentary side elevation as in FIG. 4, showing the mechanism of this invention in its operated condition; and

FIG. 6 is a still further enlarged side elevational view in section of the pressure-operated plunger by which the operation of the inoculator is controlled.

The objects of this invention are achieved, in its preferred form, by providing a latch to hold the gas-operated piston of the gun against movement until the pressure of the gas reaches a predetermined value. The latch is released by a small plunger extending through the gun housing from the cylinder for the piston and thus subject at one end to the pressure of the gas in said cylinder. When the pressure in the cylinder reaches the predetermined value, the plunger overcomes the resistance of the latch and trips the latch to free the piston. A valve in the plunger and operated by the gas-operated piston shuts off the gas to the cylinder when the said piston is freed, so that when the gas is exhausted at the end of the working stroke of the said piston and is returned by the spring provided for this purpose, the latter piston-holding latch is reset and the plunger is returned by the latch to its initial position. The valve in the plunger is pushed open by the entrapped gas which is pressurized by the return movement of the gas-operated piston. The valve is then held open by the piston in end position of the latter. The resistance of the latch to movement of the plunger is provided by a spring which is adjustable to vary the gas pressure at which the inoculation is effected.

Referring now to the drawings, FIG. 1 is a general assembly drawing partly in section of a gas-operated inoculator gun which incorporates this invention. The gun is, in general, similar to that shown in my U.S. Pat. No. 3,292,622, and is comprised of a housing **10** having a cylinder **11** formed therein, in which is reciprocated a piston **12** for pressurizing the medicament to be injected. Piston **12** is connected through a suitable rod **13** to a force pump shown only in exterior outline at **14**, said force pump extracting medicament in predetermined dosages from a vial **15** secured in inverted position to pump **14** by a clamp **16**. Said force pump **14** forces the medicament through a nozzle **17** which has a small orifice to create a small stream **18** of the medicament ejected at high pressure into the skin of the patient. The pressure of the medicament as it leaves the nozzle **17**, is sufficient to pierce the skin of the patient.

Piston **12** is adapted to be moved to the left, as shown in FIG. 1, on its working stroke by a gas such as CO_2 under a pressure of about 200 pounds per square inch and contained in a bottle **19** which may be retained in a hollow handle **20** secured to the housing **10** of the gun. Where the gun is to be used to give an occasional inoculation, a small bottle of approximately 8.5 grams of CO_2 at 800 pounds per square inch may be sufficient, and such bottle is of a small enough dimension to be retained in the handle **20**. Where many people are to be inoculated at the same time, the CO_2 may be obtained from a large cylinder connected through suitable tubing to the gun.

The gas is fed through a hollow tube indicated generally at **21**, to a trigger-operated valve **22**, and from said trigger-operated valve through a passageway **23** in the housing **10** to the control valve **24** of the delay mechanism and thence to cylinder **11**. A trigger **25**, controlled manually, operates a plunger **26** which, in turn, operates the trigger-operated valve **22**.

In prior inoculator guns not equipped with the delayed action device of this invention, the operation of trigger-operated valve **22** allowed gas under pressure to enter cylinder **11** behind piston **12**, and just as soon as the pressure exerted by piston **12** overcame the pressure of the return spring **27** for said piston, said piston moved to the left and operated pump **14**. This frequently resulted in a movement of the piston which was too slow to develop the requisite impact pressure in pump **14** and consequently the inoculant **18** did not leave the nozzle **17** with a sufficiently high pressure to pierce the skin of the patient. It has been found that a high initial inoculant pressure is required to pierce the skin, but once it is pierced the pressure can diminish considerably without detracting from the effectiveness of the inoculant; that is, without creating a corresponding diminution in the quantity of inoculant injected. It is important, therefore, that the inoculant be initially highly pressurized, as by a sudden activation of the piston **12**, rather than by a gradual movement thereof.

Referring now to FIG. 4, there will now be described the plunger and the mechanism by which the piston is restrained until sufficient pressure is built up behind it to pressurize adequately the inoculant. In FIG. 4 it will be observed that piston **12** has secured to the rear end thereof, a rod **28** on the end of which is threaded a nut **29**. Between nut **29** and housing **10** are disposed a plurality of hook-shaped gages **30** (FIG. 1) the function of which is to intercept nut **29** after a predetermined distance of travel thereof, so as to arrest piston **12** and its associated pump **14** to regulate the quantity or dosage of the inoculant injected in a patient. As shown more clearly in FIG. 2, said gages **30**, when hooked over rod **28**, arrest the nut **29** and its associated rod **28** and piston **12**, so that by rotating said gages **30** out of the way of said nut in a predetermined number, the dosage can be regulated.

The delay device of this invention is designed to utilize nut **29** as a means for holding piston **12** against movement in its cylinder **11** until sufficient pressure has been built up in said cylinder behind piston **12** adequately to pressurize the inoculant.

The delay device is comprised of an oscillatable trigger 31 pivoted on a pin 32 which, as shown more clearly in FIG. 3, is held by the sides of a U-shaped bracket 33. Said bracket 33 is provided with diverging attaching flanges 34 and 35 by which, as shown in FIG. 2, it is secured to housing 10. Trigger 31 has spaced ears 36 and 37 between which nut 27 may be retained. Ear 36 serves to act as an abutment to prevent movement of nut 29 and its associated rod 28 and piston 12 to the left, as viewed in FIG. 4, and ear 37, as will become apparent hereinafter, serves to rotate trigger 31 back to the position shown in FIG. 4, after said trigger has once been released and piston 12 operated.

At the bottom of trigger 31, as shown in FIG. 4, there is formed a tooth 38, similar to a ratchet tooth with which is adapted to cooperate a latch 39. Said latch 39 has a tooth 40 in engagement with tooth 38, said latch being pivoted at 41 on a pin which is likewise retained by the sides of the U-shaped bracket 33. A leaf spring 42 is disposed in the space between latch 39 and the bottom 43 of the U-shaped bracket. Leaf spring 42 has an end 44 which is hooked under said bottom 43 and is clamped thereto by a nut 45 threaded over a thumbscrew 46. The latter is, in turn, threaded in bottom 43 and extends therethrough into contact with the leaf spring 42. The pressure exerted by spring 42 against latch 39 can be regulated by thumbscrew 46, and the pressure selected can then be fixed by nut 45 which acts as a lock nut for thumbscrew 46.

Latch 39 has a vertical arm 46 which extends upwardly in proximity to a plunger 47 forming part of the control valve 24. As shown more clearly in FIG. 6, plunger 47 is slidable in a bore 48 which communicates with passageway 23 from the trigger-operated valve 22. Said plunger has a peripheral groove 49 connected by cross bores 50 to a central recess 51 in plunger 47 which communicates with cylinder 11 behind piston 12 and constitutes the means by which gas under pressure is introduced into said cylinder.

Within central recess 51 is disposed a three-step valve 52 the largest step 53 being slightly loose in the central recess to allow the gas to pass around it into the recess. The central step 54 has clearance between itself and said bore to allow gas to pass freely therebetween, and the smallest step 55 extends out of the plunger to the left into contact with the back of piston 12. Between steps 54 and 55 is a shoulder 56 which functions as a valve with a seat 57 formed in an insert 58 pressed into the end of plunger 47. A pair of O-rings 59 disposed around plunger 47 at the sides of peripheral groove 49 seal the groove from the atmosphere.

The right-hand end (FIGS. 4—6) 60 of the plunger 47 extends out of the housing 10 into contact with the adjacent face 61 of the vertical arm 46 of latch 39. The latter is held against rotation by spring 42 as aforesaid.

The operation of the device is as follows:

Initially, the parts of the inoculator assume the positions shown in FIGS. 1 and 4. Piston 12 is at the right hand end of its cylinder 11 and has contacted and moved valve 52 into it recess 51, so that shoulder 56 is off its seat in insert 58 and hence is in its open position. Plunger 47 bears against arm 46, but spring 42 holds arm 46 and pawl 39 with the tooth 40 thereof in engagement with tooth 38 of trigger 31.

When an operation of the inoculator is desired, the physician presses trigger 25 to open valve 22 which then admits gas under 800 p.s.i. to passageway 23. The gas under pressure passes into peripheral groove 49, cross bores 50 and recess 51 where same travels to the bottom of said recess behind the end of valve 52 and the remainder goes around valve 52 past insert 58 and into cylinder 11 behind piston 12. When the resistance of return spring 27 is exceeded by the gas pressure in cylinder 11, piston 12 will try to move to the left as viewed in FIG. 1, but it will be held back by trigger 31.

The gas in cylinder 11 simultaneously pushes against the end of plunger 47 which, in turn, pushes against arm 46 to turn latch 39 and release trigger 31. Spring 42 resists plunger 17, in the example shown, with a 3-to-1 mechanical advantage. Thus pressure continues to build up in cylinder 11 instead of being dissipated in movement of the piston, until said pressure reaches a predetermined value. Said value in one form was found to be satisfactory at 200 p.s.i. It may be apparent that the lower the pressure the less volume of gas used. At such pressure, spring 42 gives way, latch 39 is turned clockwise, as viewed in FIG. 5, and trigger 31 is pushed out of the way by nut 29 as piston 12 is freed to perform its work.

As soon as plunger 47 moves away from piston 12, valve 52 is pushed by the pressure of the gas in recess 51 behind said valve upon seat 58 to close said recess to the cylinder 11. This shuts off further flow of gas under pressure to cylinder 11, and piston 12 is moved by the expansion of the gas held captive behind said piston. The movement of piston 12 is extremely fast and creates a tendency to spin trigger 31 around pin 32 and excessive amount which would leave it in an undesired position for the next cycle. Accordingly, movement of trigger 31 is slowed by the introduction of a ball 62 (FIG. 3) held by a spring 63 against a hole 64 inside of U-shaped bracket 33. Spring 63 is in a recess 65 in trigger 31 and hence reacts upon said trigger to hold it against the opposite side of the bracket. This creates a friction force which further retards the free movement of trigger 31 so that after nut 29 passes over the trigger, the latter assumes the position shown in FIG. 5. The expanded gas in cylinder 11 will remain captive therein as long as the trigger 25 is held in its operative position by the physician.

When the physician releases trigger 25, valve 22 is so constructed that it will exhaust passageway 23 and the cylinder 11 connected thereto. With the gas exhausted out of said cylinder, return spring 27 becomes effective to push piston 12, its rod 28 and nut 29 back to the position shown in FIG. 4. In the process, nut 29 engages ear 37 and turns trigger 31 in a clockwise direction as shown in FIGS. 4 and 5, until tooth 40 of latch 39 again engages tooth 38 of trigger 31 because of the continuous upward pressure exerted by spring 42 against latch 39.

Thus the device of this invention provides a means for preventing operation of a gas-operated inoculator until a predetermined pressure is created in the operating cylinder of the inoculator, and if such pressure is not available because of exhaustion of the source, the inoculator will not operate to produce an incomplete inoculation and hence will not waste the inoculant. Should the physician wish to inoculate a child with its typically tender skin, he can reduce the operating pressure by appropriately adjusting thumbscrew 46 to reduce the pressure exerted by spring 42.

It is understood that the foregoing description is merely illustrative of a preferred embodiment of the invention and that the scope of the invention therefor is not to be limited thereto, but is to be determined by the appended claims.

I claim:

1. In combination a pressure fluid operated device comprising a housing forming a cylinder, a piston in said cylinder adapted to perform work, an abutment rigidly connected to said piston, a trigger pivoted on said housing and adapted to cooperate with said abutment to hold or release said abutment, a source of gas under pressure for moving the piston in one direction, means forming a passageway connecting the gas source with the cylinder on one side of said piston to move said piston in said one direction, a valve in the passageway and controlling passage of gas therethrough, and means operated by the pressure of gas under predetermined unit pressure in said cylinder for operating said trigger to release said trigger and said abutment on said piston.

2. The combination described in claim 1, said abutment comprising a rod secured to said piston and extending through the housing to the exterior thereof, and a radially disposed face on said rod cooperable with said trigger.

3. The combination described in claim 2, there being a return spring in the cylinder to move the piston and rod in the opposite direction to said one direction, an abutment on the trigger, engageable by said rod for reversing the movement of the trigger upon movement of said piston, and rod in the opposite direction, whereby to reset the trigger.

4. The combination described in claim 1, said means operated by the presence of gas under predetermined pressure including a shutoff valve, and means movable with the piston for operating said shutoff valve whereby to fix the quantity of gas under pressure in the cylinder.

5. The combination described in claim 1, said means operated by the presence of gas under predetermined pressure comprising a plunger in the housing and exposed on one side to the pressure of the gas in the housing, a pivoted latch bearing against the other side of said plunger, a spring bearing against said latch to hold it against said plunger, said trigger adapted to be held in one position by said latch, said trigger in its latch-held position providing an abutment against which the abutment connected to said piston may bear.

6. The combination described in claim 5, and means for adjusting the pressure of the spring against the latch, whereby to adjust the unit pressure of the gas at which the latch is operated by the plunger.

7. The combination described in claim 5, said spring comprising a leaf spring, a plate secured to the housing, said spring having its end hooked around said plate, aligned openings in the hooked end and in the plate, said opening in the plate

being threaded, and a thumbscrew in the openings and bearing against the spring to adjust the pressure of the spring against the latch, said thumbscrew also holding the spring on the plate.

8. The combination described in claim 5, said means operated by the pressure of gas under predetermined pressure including a shutoff valve disposed in the plunger, and means movable with the work piston for operating said shutoff valve, whereby to fix the quantity of fluid under pressure in the cylinder.

9. The combination described in claim 1, and means interposed between said housing and said trigger to retard movement of said trigger.

10. The combination described in claim 1, said housing comprising a U-shaped bracket, said trigger being pivoted between the sides of the "U," a recess in the side of the trigger adjacent one of the sides of the bracket, and a ball and a spring in said recess, said spring pressing the ball against one side of the "U" and the trigger against the other side of the "U" to create friction forces to retard movement of said trigger relative to said bracket.