Dec. 8, 1964 R. R. TYLER 3,160,156

ARTIFICIAL INSEMINATION DEVICE

Filed Jan. 16, 1961

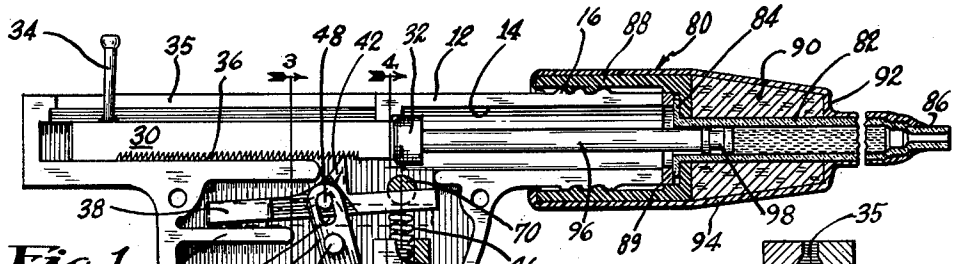

Fig. 1.

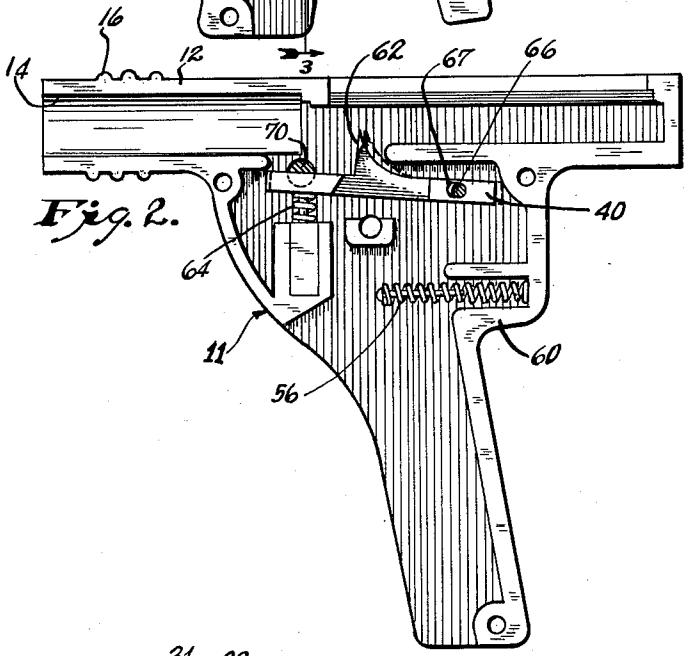

Fig. 2.

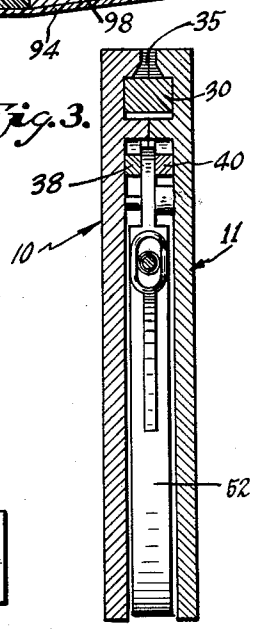

Fig. 3.

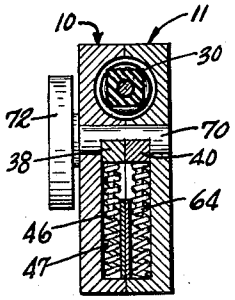

Fig. 4.

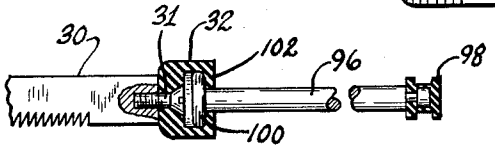

Fig. 5.

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ARTIFICIAL INSEMINATION DEVICE

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This invention relates to a multiple-shot syringe adapted to administer a plurality of successive uniform shots of liquid material, and especially to an artificial insemination gun or syringe device for artificially inseminating turkeys and other fowl.

As is well known in the poultry industry, normal mating activities of poultry, and especially turkeys, result in considerable injury to the birds. Artificial insemination is desirable both to avoid such injury to the birds and to secure better control of breeding and a higher percentage of fertility.

It is the object of the invention to provide a convenient and effective insemination gun or syringe device, which may be loaded with a multiple-dose quantity of liquid material from a supply of such material, for example, a quantity of diluted fresh insemination liquid, and will discharge the same accurately in successive uniform small shots or doses. It is a special object of the invention to provide an insemination gun or syringe device which may be loaded with say a 50 shot quantity of diluted insemination liquid and will maintain such liquid in viable condition during administration, and which will be safe, effective, and convenient to use and which will dispense the liquid in successive, uniform and effective shots with a high degree of accuracy and with little or no loss.

In accordance with the invention, I preferably use an injection gun of the characteristics of that shown in Patent No. 2,624,338, or its equivalent, in inter-related combination with a syringe adapted to handle liquid material. Such gun comprises a manually operable squeeze handle, which actuates a driving pawl in successive forward steps to advance a plunger having uniformly spaced rack teeth in which the pawl engages. The plunger rack is also engaged by a holding pawl which has limited lost motion movement relative to its support, and both pawls are biased into engagement with the rack. The patent structure was intended for dispensing semi-solid plastic material under high pressure, and the holding pawl is biased forward with a low but definite spring force.

The present invention is for dispensing liquid material, as distinguished from the semi-solid material of the patent, and the gun used is modified. The holding pawl is not biased forward, but is preferably free in its lost motion movement. The arrangement is such that during each advance step of the plunger, the holding pawl is at first moved forward with the plunger to the limits of the lost motion of such pawl, and is then held stationary while the plunger advances further forward a sufficient distance to carry the next tooth of the plunger rack past the holding pawl. As the holding pawl drops into the next tooth space it produces an audible snap which marks the end of the forward stroke. On the return stroke, the driving pawl at first drags the plunger with it in its rearward movement, until the holding pawl has moved to the limit of its rearward lost-motion movement. The plunger is then held stationary while the driving pawl moves rearward a further distance sufficient to carry it past the next rearward tooth, when it snaps into the next tooth space in readiness for the next dispensing stroke.

Thus, the plunger is driven forward in successive forward steps, and after each step is slightly retracted by an amount depending on the lost-motion in the holding mechanism. In combination with such a driving and retracting plunger or like ratchet element the present invention combines a syringe for administering liquid material, and by interaction between them, provides an effective and practical multiple-shot device which administers uniform small quantities of liquid material.

In combination with a gun having an advancing and partially retracting plunger, I provide a syringe body defining a multiple-dose cylinder having a restricted discharge tube or nozzle at its forward end, and I connect the displacement plunger of such syringe to the plunger of the gun, by a lost motion connection having an amount of lost motion preferably greater than the retraction movement of the gun plunger at the end of each stroke. For insemination use, the rear portion of the syringe body is desirably surrounded by an insulating body, such as of cork, in order to maintain a viable temperature in the contents of the syringe, and such insulating body forms a shoulder intermediate the length of the syringe leaving a predetermined length of the syringe extending forward for insertion during use, with the shoulder serving as a stop to gauge the depth of insertion.

In operation, as the manual squeeze handle is actuated, it drives the actuating plunger forward, first to take up any lost motion, and then to advance the syringe plunger to discharge through the nozzle of the syringe body an accurate measured quantity of fluid, usually only a small fraction of a cubic centimeter. At the end of the actuating stroke, the holding pawl will snap from one tooth to the next tooth of the rack of the gun plunger. As the operator then releases the squeeze handle, the slight retraction of the gun plunger relieves the thrust on the syringe plunger and permits such plunger to retract slightly to relieve the stress in its forward head, which causes the liquid in the nozzle of the syringe body to be withdrawn slightly into such nozzle so that no dripping occurs between actuations of the device. Each successive actuation takes up the existing lost motion and advances the actuating plunger and the syringe plunger a predetermined distance forward, so that successive accurate doses are administered.

The accompanying drawing illustrates the invention. In such drawing:

FIG. 1 is a side elevation of the left-hand half of an artificial insemination gun embodying the invention, with the right half removed to show the mechanism, and with the syringe portion of the device shown in longitudinal section.

FIG. 2 is an elevation of the right-hand half of the gun shown in FIG. 1, viewed from the opposite side from that of FIG. 1;

FIG. 3 is a section on the line 3—3 of FIG. 1 showing the gun assembled;

FIG. 4 is a section on the line 4—4 of FIG. 1, showing the gun assembled;

FIG. 5 is a fragmental view showing in section the connection between the syringe plunger and the actuating plunger.

The injection gun shown in the drawing is conveniently made of two casing parts separable in a longitudinal plane, the left-hand part 10 being shown in FIG. 1, and the right-hand part 11 being shown in FIG. 2. The two parts 10 and 11 are complementary, and when assembled form the body of the gun. The front of such body is in the form of a barrel 12 defining a forward passage 14 providing travel space for the plunger described below. The front of the barrel carries external threads 16 for attachment of a syringe assembly.

Rearward of the passage 14, the casing is formed to provide a guide chamber for a plunger 30. Conveniently, the plunger 30 is of rectangular cross section, with a diagonal dimension somewhat less than the internal diameter of the passage 14, and its forward end is axially bored and threaded to receive a retaining screw 31 for a

coupling 32 shown in FIG. 5. The rear of the plunger carries an upward projecting pin 34 riding in a slot 35 in the casing 10–11 to give a visual indication of the position of the plunger and to serve as a handle for its direct manipulation, as during assembly and cleaning of the syringe and especially for loading the syringe with liquid to be administered.

The lower surface of the plunger 30 is formed as a rack 36 whose teeth are uniformly spaced a suitable distance to provide the advance movement required for the displacement desired on each actuation of the gun. The rack 36 is engaged by two pawls 38 and 40, lying side by side in a compartment formed immediately below the rack 36. The driving pawl 38 is in the form of a straight bar having an upstanding tooth 42. Its rear end rides on the lower wall 44 of the pawl-containing compartment, and its forward end is yieldingly urged upward by a spring 46 mounted in a vertical bore 47 in the casing part 10. Such pawl 38 carries a pin 48 which is received in a slot 49 in the lever arm 50 of the squeeze handle or trigger 52. The trigger 52 is pivotally mounted by a pin 54 supported by the casing parts 10 and 11. The lever arm 50 above such pivot 54 is relatively short with respect to the lower arm of the trigger 52, to provide a high mechanical advantage. This may be of the order of 12 to 1 so that a relatively large throw of the squeeze handle 52 is required to advance the plunger 30 through a full tooth space of the rack 36. The handle of the trigger 52 is yieldingly urged forward by a pair of spring-pressed plungers 56 mounted in grooves in the handle portion 60 of the gun.

The holding pawl 40 is similar in shape to the driving pawl 38, and is similarly provided with an upstanding ratchet tooth 62 to engage the rack 36. Its front end is yieldingly urged upward by a spring 64, and its rear end is positioned by a cross pin 66 carried by the casing and passing through a slot 67 in the pawl. Such slot is of limited elongation, to permit and limit longitudinal lost-motion movement of the pawl 40.

Overlying the forward ends of the pawls 38 and 40 there is a transverse pin 70, half cut away where it crosses the pawls, to form a pawl retracting cam. A handle 72 on the end of such cam pin 70 permits it to be rotated to depress the front ends of the pawls and retract them from engagement with the rack 36.

As previously indicated, the forward end of the barrel 12 of the gun is provided with external threads 16 for attachment of a syringe assembly 80. This comprises a cylindrical syringe body or barrel 82 having a flange 84 at its rearward end and formed at its forward end to provide a reduced neck or nozzle 86. Conveniently, such syringe body 82 may be a conventional commercial unit, preferably one formed of unbreakable plastic material, in order to avoid danger of breaking in use. This syringe body 82 is received through an opening in the end wall of a cap 88 which is internally threaded for reception over the external threads on the barrel 12 of the gun. The syringe body is suitably secured in place in the cap 88, as by cementing its rear end to the wall of the cap 88. A resilient washer 89 may be interposed between the flange 84 of the syringe body 82, and the forward end of the barrel 12.

The syringe body 82 is desirably surrounded by an insulating body 90, as of cork, to aid in maintaining the contents of the syringe at a viable temperature. Desirably, however, the cork 90 extends only part-way toward the forward end of the syringe body, and its forward end forms a shoulder 92 at a suitable position to limit the insertion depth of the syringe in use. A protective coating 94 of synthetic resin is desirably applied over the entire syringe assembly 80, from the rear edge of the cap 88 forward to the base of the nozzle 86.

The syringe is provided with a displacement plunger comprising a rod 96 having a forward resilient head 98 which forms a displacement piston in the syringe barrel

82. The rear end of the rod 96 carries a flanged head 100, which is connected to the plunger 30 of the gun by the coupling 32 shown in FIG. 5. Such coupling is desirably of molded elastic material and of generally cup-shaped configuration. It is secured by its bottom wall to the forward end of the gun plunger 30 by the retaining screw 31. Its forward edge carries an inwardly extending flange 102 axially spaced from the bottom wall a distance greater than the thickness of the head 100 on the syringe plunger 96. The elastic coupling 32 may be stretched sufficiently to permit insertion of the plunger head 100 to a position behind its flange 102. The coupling will then loosely retain the head in the space between its rear wall and its front flange 102, to provide a limited lost motion connection between the gun plunger 30 and the syringe plunger 96. Desirably, the lost motion in this connection is greater than that in the mounting of the holding pawl 40.

In a preferred embodiment giving fifty shots per loading, the tooth spacing between the teeth of the rack 36 on the gun plunger 30 is one-twentieth of an inch, so that there are somewhat more than fifty teeth over the length of the rack 36. With this arrangement, the gun plunger 30 will be advanced one-twentieth of an inch upon each actuation of the squeeze handle 52. The size of the syringe body 82 may be chosen in relation to this one-twentieth-inch stroke to give a desired displacement within a wide range of values, say from one-twentieth of a cubic centimeter down to one-sixtieth of a cubic centimeter. I commonly use a syringe body of a size which gives a delivery of one-forty-fifth cubic centimeter for each stroke of the squeeze handle 52.

To prepare the syringe apparatus for use, the gun plunger 30 is advanced to its foremost position, as by depressing the pawls 38 and 40 with the cam 70 and moving the plunger forward by its upstanding handle 34. The head 100 of a syringe plunger 96 is then manually engaged in the elastic coupling 32, and with the forward head or piston 98 of the syringe plunger in place in the barrel of a syringe assembly 80, the syringe assembly is slipped on to the end of the gun barrel 12, and secured by engagement with the threads 16. This assembly is conveniently made with the cam 70 in position to hold the two pawls 38 and 40 out of engagement with the rack 36 on the gun plunger 30. With the pawls thus retracted, the gun plunger 30 can be freely moved forward and rearward to advance and retract the piston 98 in the syringe barrel 82, by means of the handle 34 at the rear of the plunger 30. By so moving the piston 98 to its advanced position, then dipping the nozzle 86 of the syringe in a supply of insemination liquid or other liquid material to be administered, then withdrawing the piston 98 in the syringe barrel, such liquid is drawn into the barrel, to fill the syringe. When the syringe is filled, the cam 70 is moved to its position shown in FIGS. 1 and 4, which returns the pawls 38 and 40 to engagement with the rack 36 on the gun plunger 30. Accurate small quantities can now be discharged by the syringe through the nozzle 86 by successive squeeze operations of the manual handle 52 of the gun.

As indicated in FIG. 5, there will be at least a small amount of lost motion between the bottom wall of the coupling 32 and the head 100 of the plunger 96 of the syringe. Accordingly, during initial movement of the squeeze handle 52 and the initial advance movement of the driving pawl 38 and the driven plunger 30, this lost motion will be taken up, to place the plunger 30 in firm thrust relation with the syringe plunger 96. Concurrently with the take-up of this lost motion, the holding pawl 40 will be carried forward by the gun plunger 30 to the forward limit of the lost motion permitted by the mounting 66–67 of that holding pawl 40. Further advance movement of the driving pawl 38 will then cause positive actuation of the syringe plunger 96, to advance the piston 98 in the syringe barrel, and to ad-

vance the driving plunger 30 with respect to the holding pawl 40. As the next tooth of the rack 36 is carried past the holding pawl 40, that pawl will drop into the next tooth space and will make a clearly audible noise, which will indicate that the gun has been actuated to the end of a full forward stroke.

The operator will then release the handle 52. As such handle moves to the position shown in FIG. 1, under the influence of its spring 56, it carries the driving pawl 38 rearward. This, being spring pressed into engagement with the rack 36, tends to move the gun plunger 30 rearward, and some rearward movement is permitted by reason of the lost motion mounting of the holding pawl 40. Accordingly, both the plunger 30 and holding pawl 40 will move rearwardly to the rearward limit of such lost motion mounting, which will retract the gun plunger 30 from the syringe plunger 96 and will relieve all pressure of the piston 98 against the fluid in the syringe barrel 82. The piston 98 is commonly of a resilient material, and is therefore slightly distorted and stressed during its forward stroke. When the gun plunger 30 is slightly retracted as described above, this permits the resilient piston 98 to relax to an un-stressed condition, which has the effect of withdrawing the liquid in the syringe slightly backward from the tip of the nozzle 86 to prevent dripping or leaking between strokes.

After the holding pawl 40 has reached the limit of its rearward motion permitted by its lost motion mounting, it then holds the plunger 30 against further retraction, so that the further rearward movement of the driving pawl 38 carries that pawl rearward along the rack 36 into engagement with the next tooth space. This again produces an audible click, which informs the operator that the gun is now ready for a successive stroke. The throw of the squeeze handle is limited to prevent the driving pawl 38 from travelling beyond the next tooth space.

In the operation of the device, the lost motion mounting of the holding pawl 40 permits a short initial retraction movement of the driving plunger 30 during the initial portion of the return stroke of the handle 52, to relieve all pressure on the piston 98 and the liquid in the syringe barrel. Also, the lost motion connection between the plunger 30 and the syringe plunger 96 permits this stress relief to occur without any positive retraction movement of the syringe plunger 96. Accordingly, the two lost motion connections provide this desired stress-relief, but limit the action to stress relief, and do not impose any positive retraction motion or pressure on the syringe plunger 96. The stress relief prevents any loss of fluid through the nozzle 86 between strokes, yet there is no retraction motion of the piston 98 tending to cause fluid to be sucked into the nozzle during a return stroke. The result is that accurate small quantities of uniform size can be successively discharged through the nozzle 86 until the entire contents of the syringe body is used up.

In use, the operator loads the syringe barrel with fresh diluted insemination fluid. He then inserts the forward end of the syringe assembly 80, to a depth determined by the shoulder 92, and actuates the squeeze handle 52 through one stroke. This administers a predetermined quantity of fluid, fixed by the spacing of the teeth on the rack 36 and by the size of the cylinder of the syringe body 82. Each operator usually works with one or two helpers, who catch the birds and hand them to the operator. The invention permits the artificial insemination procedure to be carried out rapidly and conveniently. The accuracy with which the shots are administered permits each shot to be small, as of the order of a fraction of a cubic centimeter, and this in turn permits a multiple-shot quantity of liquid to be carried in the cylinder 82 of the syringe, so that a large number of birds may be treated without stopping to re-load the syringe.

While the invention has been exemplified in a syringe device for artificial insemination, and is especially advantageous for this purpose, it is not limited to this use and in its broader aspects is applicable to other situations in which it is desired to inject or similarly administer a plurality of successive shots of liquid material.

I claim as my invention:

1. A multiple-shot syringe adapted to administer a plurality of successive uniform doses of liquid material, comprising a syringe barrel defining a fluid-receiving cylinder and having a restricted discharge conduit at its forward end, a displacement rod movable axially in said cylinder, supporting means including a body to which said syringe barrel is secured, operating means for said rod, comprising a driven ratchet element movable axially of said cylinder for driving said rod, driving means including a driving ratchet element operatively engaged with said driven ratchet element to advance the same in successive forward steps, a manually operable handle supported from said body and operatively connected to reciprocate said driving ratchet element in successive driving and reverse movements, holding means including a holding ratchet element supported from said body and operatively engaged with said driven ratchet element to limit retraction movement thereof, said holding means including a limited lost-motion connection permitting limited retraction of said driven ratchet element from its foremost position on each forward step, said driving means including means for retracting said driven ratchet element during retraction of the driving ratchet element, a limited lost-motion coupling between said driven ratchet element and said syringe displacement rod, whereby said driven ratchet is retracted a limited amount after each rod-operating advance and is thereby withdrawn from driving thrust relation with said rod, means for effecting disengagement between said driven ratchet element and said driving and holding ratchet elements, and manually operable means, operable while said syringe barrel is secured on said supporting means, for retracting said driven ratchet element and said rod relative to said syringe barrel to load the syringe barrel with a multiple-dose supply of liquid material.

2. A multiple-shot syringe as set forth in claim 1, in which the lost motion in said coupling between the syringe displacement rod and the driven ratchet element is greater than that in said ratchet holding means.

3. A multiple-shot syringe as set forth in claim 1 with the addition that said syringe body is releasably secured to said body and said displacement plunger is releasably coupled to said driven ratchet element.

4. A multiple-shot syringe adapted to administer a plurality of successive uniform doses of liquid material comprising a syringe barrel defining a liquid-receiving cylinder and having a restricted discharge conduit at its forward end, a displacement plunger movable axially in said cylinder, driving means for said plunger comprising a thrust member for advancing said plunger, operating means including a manually actuated member for advancing said thrust member in a series of successive forward movements of uniform length, said operating means also including means to retract said thrust member a limited distance after each forward movement, a limited lost-motion coupling between said thrust member and said plunger providing an amount of lost motion not less than the limited retraction distance of said thrust member, and means operable independently of said operating means to manually advance and retract said thrust member for moving the displacement plunger substantially the full length of said cylinder as for loading the syringe.

5. A multiple shot syringe adapted to administer a plurality of successive uniform doses of liquid material, comprising a syringe barrel defining a liquid-receiving cylinder and having a restricted discharge conduit at its

forward end, a displacement plunger movable axially in said cylinder, driving means for said plunger comprising a thrust member for engaging the plunger to advance the same, operating means including a manually actuated member for advancing said thrust member in successive forward steps of substantially uniform length and slightly retracting said thrust member after each forward step, said thrust member being arranged to advance said plunger during each forward step and having sufficient lost motion relative to said plunger to avoid retracting the same by the slight retraction of the thrust member after each forward step, means for releasing said thrust member for retraction movement, and manual means, operable independently of said manually actuated member, for retracting said plunger in said cylinder for loading the same with a supply of liquid material.

6. An artificial insemination device for poultry, comprising a multiple shot syringe as set forth in claim 5 with the addition of means forming a forwardly-facing shoulder intermediate the length of the syringe cylinder for limiting insertion thereof in use.

7. An artificial insemination device for poultry as set forth in claim 6, with the addition of heat insulating means surrounding the syringe rearward of said shoulder.

8. A multiple shot syringe adapted to administer a plurality of successive uniform doses of liquid material, comprising a syringe barrel defining a liquid-receiving

cylinder and having a restricted discharge conduit at its forward end, a displacement member movable axially in said cylinder, driving means for said displacement member comprising a thrust member connected to the displacement member by a limited lost-motion coupling, operating means including a manually actuated member for advancing said thrust member in successive forward steps of substantially uniform length and slightly retracting said thrust member after each forward step, said thrust member being arranged to advance said displacement member during each forward step and having sufficient lost motion relative to said displacement member to avoid retracting the same by the slight retraction of the thrust member after each forward step, said displacement member being positively retractable in said cylinder by extended retraction movement of the thrust member, and means for effecting such extended retraction movement.

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