United States Patent [19]

Lumby et al.

[11] **3,814,007**

[45] **June 4, 1974**

[54] **INJECTING APPARATUS**

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[73] Assignee: **Land O'Lake Inc.**, Minneapolis, Minn.

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[52] **U.S. Cl.** **99/532**
[51] **Int. Cl.** **A22c 9/00,** A23b 1/16, A47j 43/16
[58] **Field of Search** .... 99/532–536, 99/516, 487, 485; 128/173 H, 173.1, 253, 347, 216, 213; 27/24 R; 239/452, 533

[56] **References Cited**

UNITED STATES PATENTS

3,035,508	5/1962	Nelson	99/533
3,738,576	6/1973	O'Neill	239/533

Primary Examiner—Leon G. Machlin
Attorney, Agent, or Firm—Frederick E. Lange

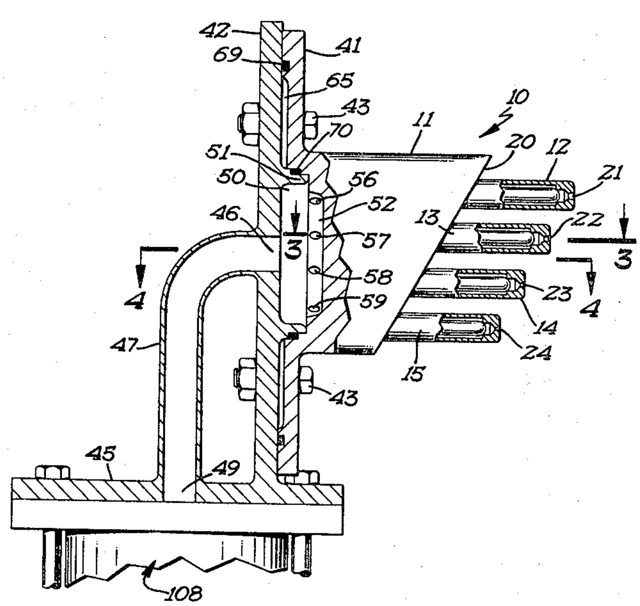
[57] **ABSTRACT**

An injector head for use in apparatus for injecting the fluid into an object in which there are one or more nozzle passages projecting outwardly with terminal portions adapted to engage the object being injected and in which there is valve means for preventing flow of fluid through the nozzle passage until the pressure of the fluid within the nozzle passage reaches a predetermined value at which time the valve means opens abruptly so as to cause a sudden release of the fluid. The injector head preferably has a plurality of nozzles and there is a valve in each nozzle. The valves preferably have their valving surfaces closely adjacent the terminal portions of the nozzle passages so that the change in pressure due to the opening of the valve is immediately transmitted to the fluid entering the object. The injector head is specifically designed for injection of an irregular object such as a turkey and the terminal portions of the nozzle passages are spaced varying distances from a vertical plane to conform with the surface of the object to be injected.

The injector head is provided with a passage for circulation of injecting fluid so that where the injecting fluid is maintained at a temperature above the ambient temperature, this insures that the injector head will be maintained at a temperature close to the desired temperature for injecting the fluid and will not cause cooling of the injecting fluid at the time of injection. In one form of the invention, an annular passage is provided for circulating such fluid. In another form, the fluid is circulated through certain of the nozzle passages until such time as the pressure is increased to injecting pressure; at this time, the flow of circulating fluid is interrupted.

In the case of an injector head for injecting a turkey, there are two rows of nozzle passages which diverge outwardly and downwardly, the nozzles projecting outwardly from a vertical plane progressively shorter distances proceeding from top to bottom. With this arrangement, the terminal portions of the nozzles fit closely against the opposite sides of the breast of a turkey or similar fowl.

11 Claims, 11 Drawing Figures



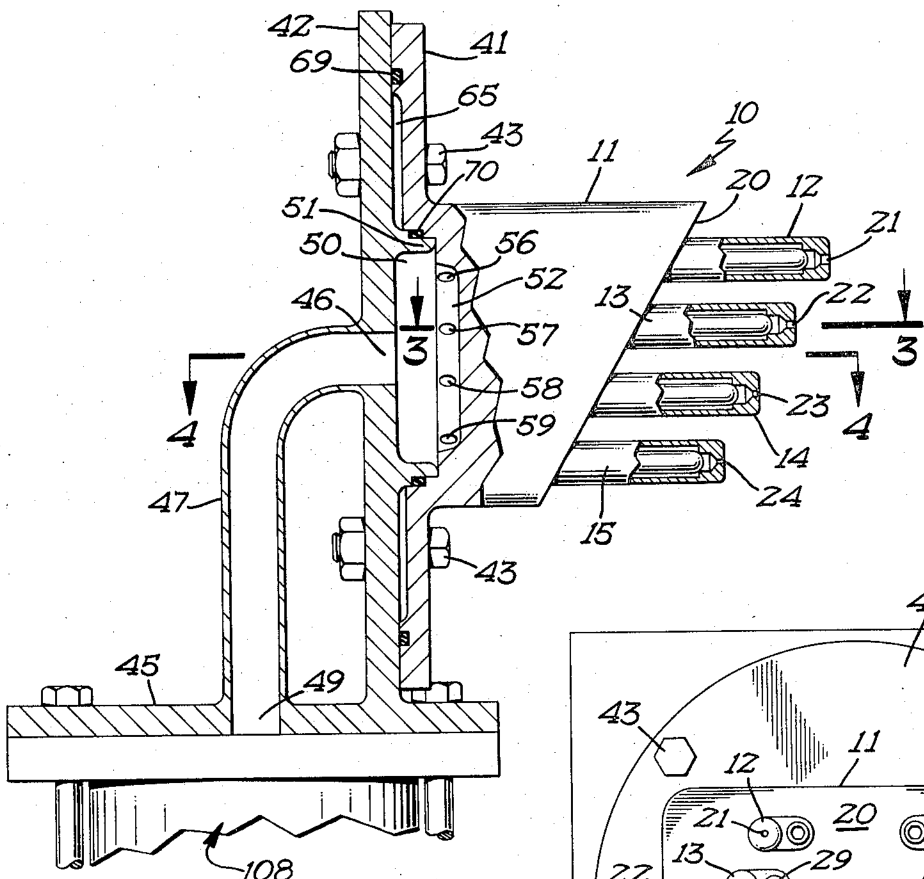


FIG 1

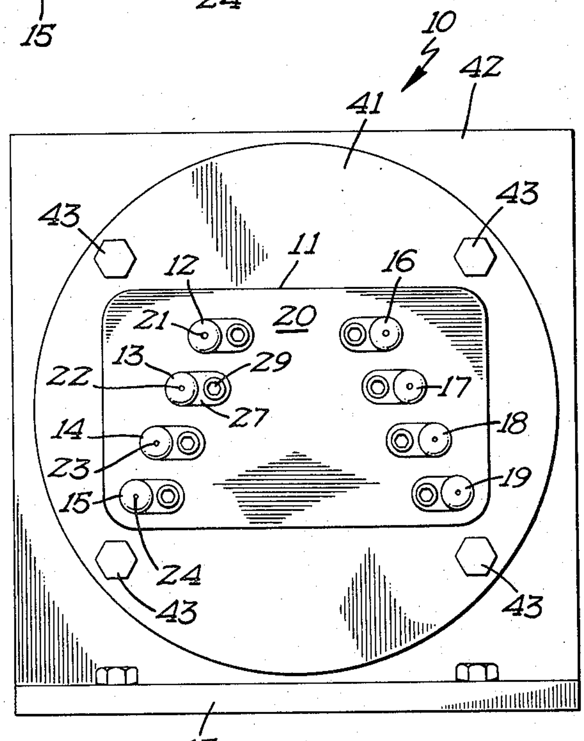


FIG 2

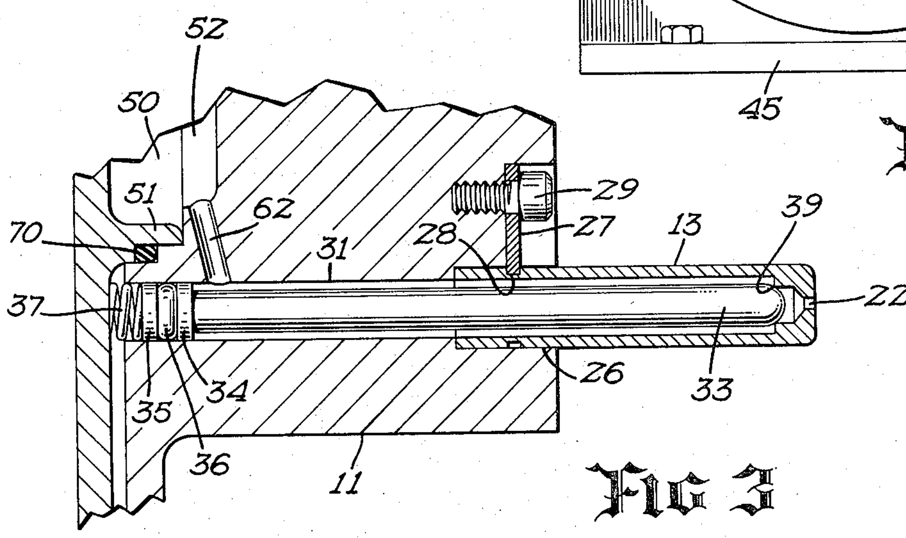
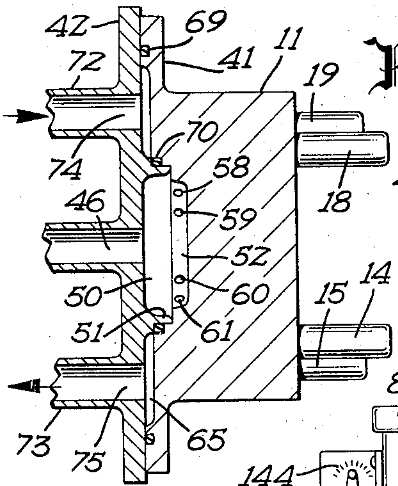


FIG 3



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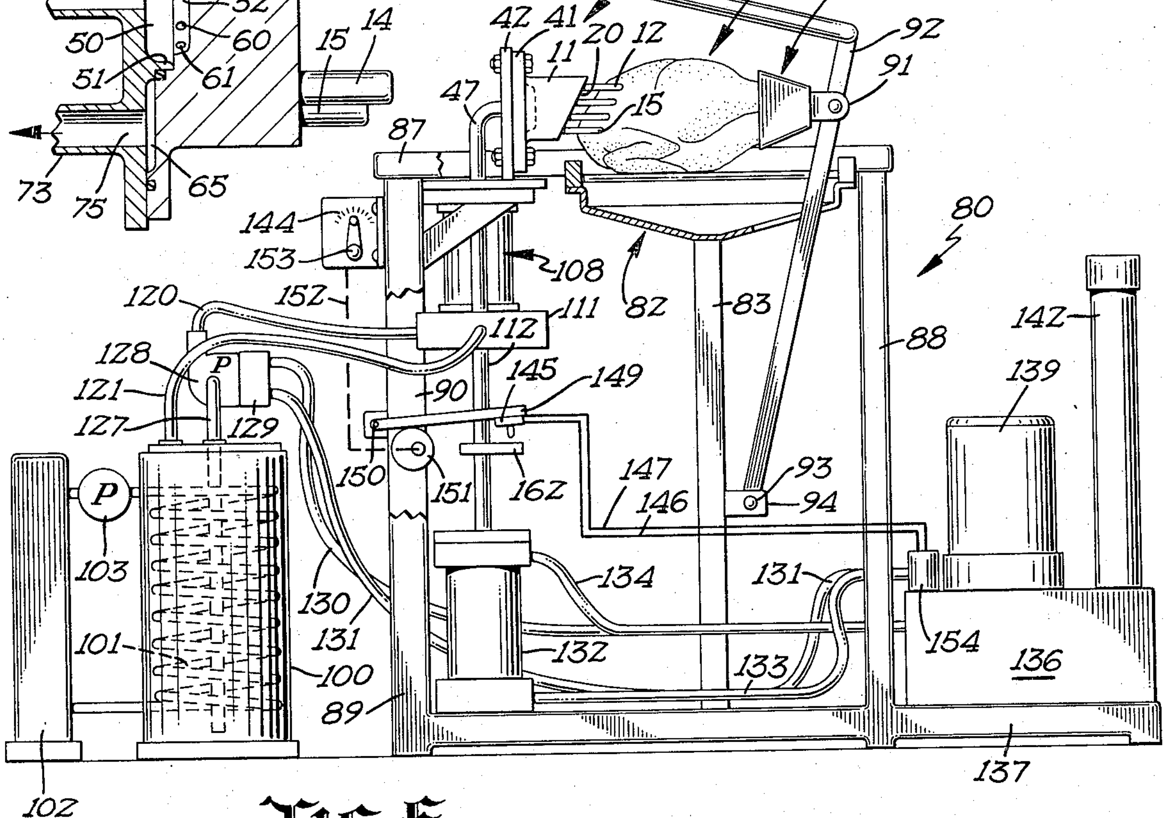
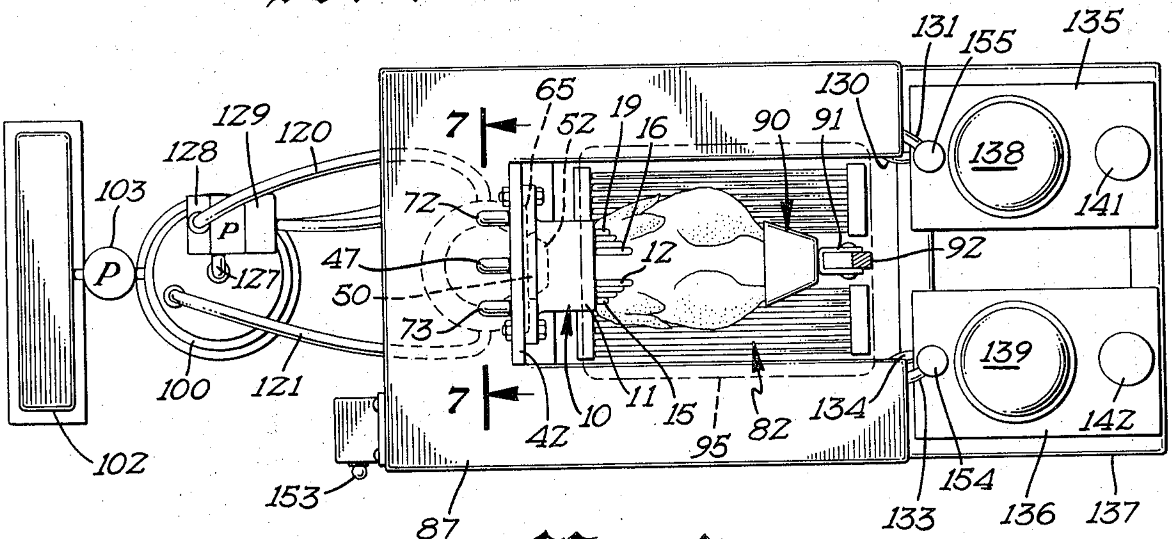


FIG 5



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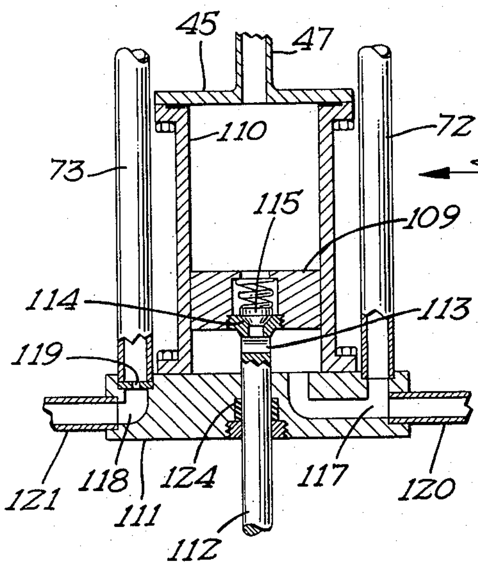

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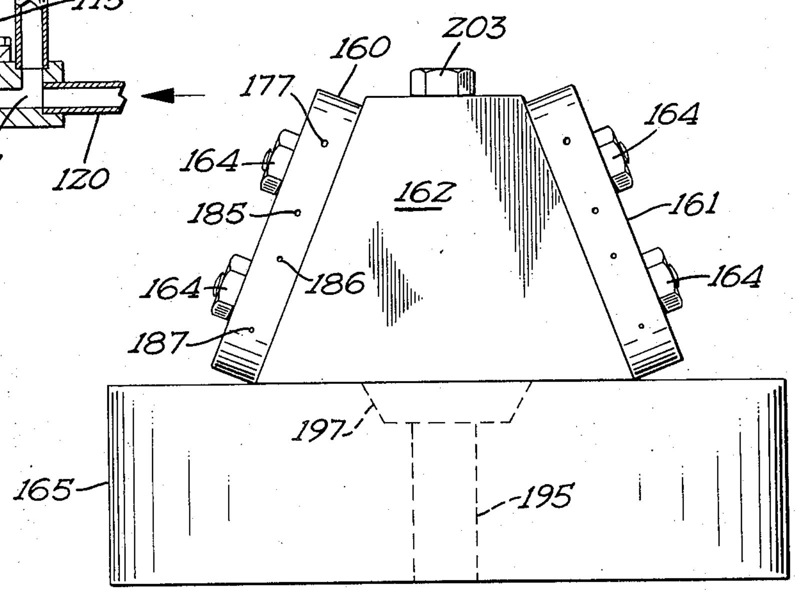

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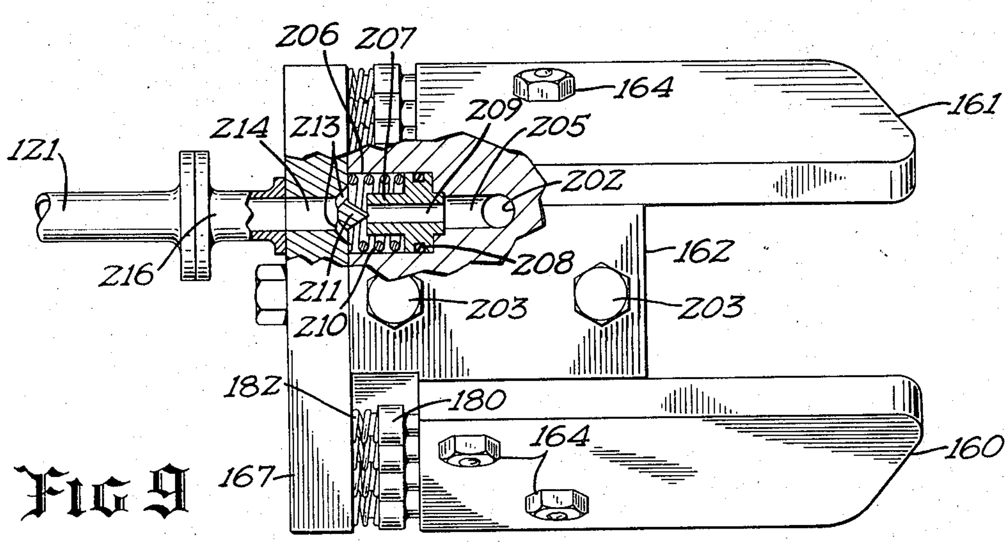

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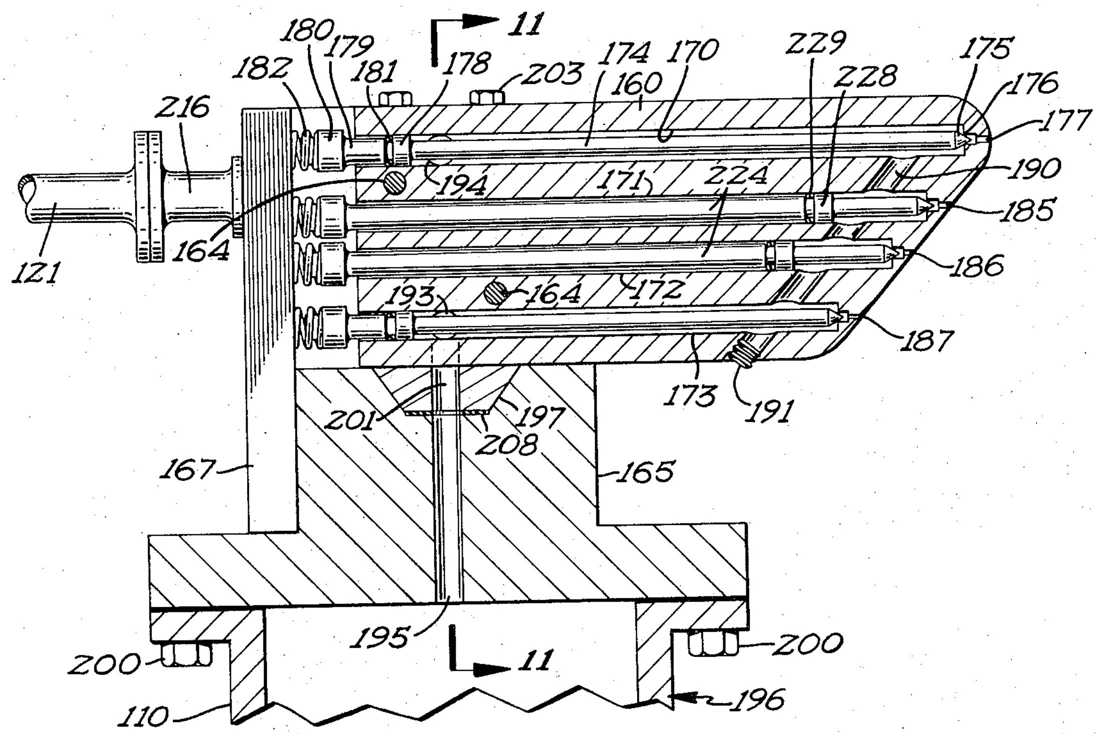
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FIG 10

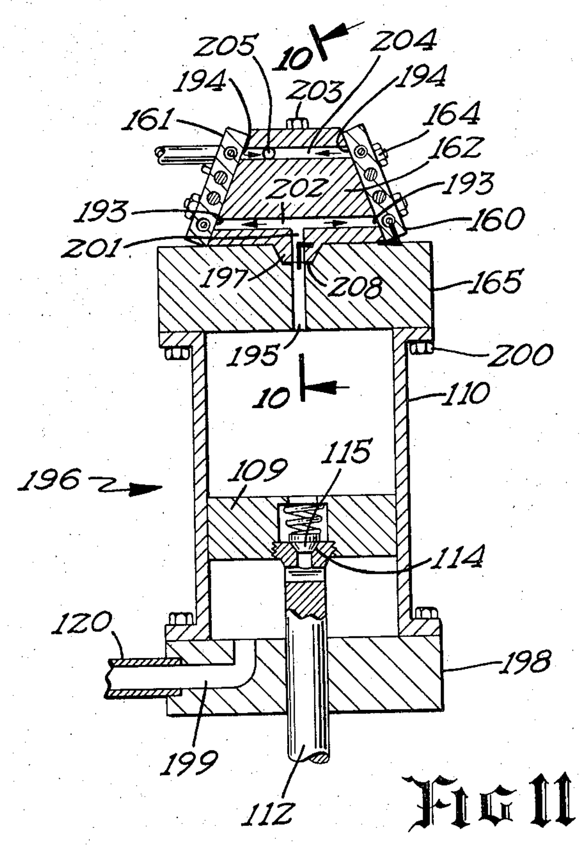
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FIG 11

INJECTING APPARATUS

BACKGROUND OF THE INVENTION

The injector head of the present invention is particularly designed for use with apparatus for injecting fluid under very high pressures. The invention is particularly applicable to the injection of a liquid additive into fowl where it is desired to introduce the additive under such high pressure that it penetrates the skin of the fowl without appreciably rupturing the same. Injecting apparatus of this type is shown in the co-pending application of Jagannath M. Kudale and Donovan H. Lumby, Ser. No. 244,804, filed Apr. 17, 1972, for Injecting Apparatus and Method now U.S. Pat. No. 3,739,713, issued June 19, 1973. In that application, there is disclosed general apparatus for injecting a liquid additive into a fowl by the use of very high pressures. The present invention is specifically concerned with an injecting head for use with such apparatus.

There has been apparatus in the past for injecting fluid into meat under high pressure. The Tichy U.S. Pat. No. 2,418,914 discusses such a method but shows no injecting unit. The patent does refer to projecting the liquid from a nozzle having a pinpoint opening and using very high pressures. There is, however, no specific discussion of the necessary apparatus. The Harper et al. U.S. Pat. No. 3,016,004 does show a plurality of nozzles in a single injector assembly. Here, however, reliance is placed entirely upon the use of relatively high pressure and the material being injected has a relatively flat surface so that the problem of firmly engaging the material being injected is relatively simple.

SUMMARY OF THE INVENTION

The present invention is concerned with an injector head in which the fluid is not released through the nozzle opening until the pressure has built up to the desired value and is then released very abruptly. This is accomplished by the use of valve means which is maintained closed until the pressure has reached the desired value, the valve means then opening rapidly. This is accomplished by providing a pressure surface on the valve which is effectively increased in area as the valve starts to open.

In its specific form, the invention is concerned with a plurality of nozzle passages which are of varying lengths and dispositions so that the terminal portions conform with the surface of an irregular object to be injected. Specifically, where the irregular object is a fowl, there are two rows of nozzles which diverge outwardly and downwardly and extend progressively shorter distances outwardly from a vertical plane proceeding from top to bottom. In this way, the nozzles are particularly adapted to firmly engage and conform with opposite sides of the breast of a fowl.

In one form of the invention, the nozzle passages are in the form of bores extending through a portion of the injector head. In another form, the nozzle passages are formed by nozzle members secured to and projecting from the injector head.

Means are provided for circulating the fluid being injected through the injector head prior to the injecting operation. Thus, where the injecting fluid is heated above ambient temperature, the head is maintained at a temperature close to that of the injecting temperature. In one form of the invention, there is a separate

annular passage for circulating the fluid prior to injection. In another form, the fluid is circulated prior to injection by circulating the same through the nozzle passages. When it is desired to inject the fluid, a valve on the outward side is automatically closed as the pressure approaches that of the injecting pressure.

Various other features of the invention will be apparent from the consideration of the accompanying specifications, claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevational view, with portions in section, of one form of our injector head;

FIG. **2** is an end elevational view of the injector head of FIG. **1**;

FIG. **3** is a fragmentary, horizontal sectional view taken along the line **3—3** of FIG. **1**;

FIG. **4** is a horizontal sectional view taken along the line **4—4** of FIG. **1**;

FIG. **5** is an elevational view, partly schematic, of an apparatus employing the form of injector head shown in FIGS. **1–4**;

FIG. **6** is a plan view of the apparatus of FIG. **5**;

FIG. **7** is a vertical sectional view of the pump for supplying liquid additive to the injector head, the section being taken along the line **7—7** of FIG. **6**;

FIG. **8** is an elevational end view of a modified form of our injector head;

FIG. **9** is a top plan view of the injector head of FIG. **8** with a portion broken away to show part of the injector head in section;

FIG. **10** is a sectional view of the injector head of FIG. **8** taken along the line **10—10** of FIG. **11**; and

FIG. **11** is a vertical sectional view of the injector head taken along the ling **11—11** of FIG. **10**, the injector head being associated with a pump for introducing high pressure fluid into the injector head.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. **1**, the injector head is broadly indicated by the reference numeral **10**. The injector head comprises a main block **11** which has a front wall **20** which slopes downwardly and backwardly. Extending out of the front wall are nozzles **12**, **13**, **14**, **15**, **16**, **17**, **18** and **19** (see FIG. **2** for nozzles **16**, **17**, **18** and **19**). Nozzles **12–15** are disposed in one row and nozzles **16–19** in another row. As can best be seen in FIG. **2**, the two rows of nozzles diverge from each other moving from top to bottom. Furthermore, as is evident from FIG. **1**, the nozzles **12**, **13**, **14** and **15** extend outwardly from the back wall of block **11** progressively shorter distances starting from the top. While not shown in the drawing, the same is true of nozzles **16**, **17**, **18** and **19**. It will be evident from FIG. **1** that the orifices **21** and **22** of nozzles **12** and **13** are larger than the orifices **23** and **24** of nozzles **14** and **15**. Similarly, the orifices in nozzles **16** and **17** are larger than the orifices in nozzles **18** and **19**. The purpose of the difference in size of the orifices and the disposition and length of the nozzles **14** and **15** will be discussed later.

Referring to FIG. **3**, the nozzle **13** is shown in section. It will be noted that this nozzle takes the form of a closed tube except for the orifice opening **22**. The open end of this tube extends into a cylindrical recess **26** in block **11**, the internal diameter of recess **26** corresponding to the external diameter of the nozzle tube.

The nozzle tube of nozzle **13** is retained in place by a plate **27** which has an arcuate inner portion engaging in an arcuate slot **28** in the nozzle **13.** The retaining plate **27** fits into a recess in block **11** and is held in position by cap screw **29.** The interior of the nozzle **13** communicates with a bore **31** in block **11** having the same internal diameter as the internal diameter of the nozzle **13** so as to form with the interior of the nozzle **13** an uninterrupted cylindrical passage. Disposed within the bore **31** and the nozzle **13** is a cylindrical valve member **33** which has at its inner end a pair of spaced collar members **34** and **35** between which is disposed an O-ring **36** which engages with the inner wall of bore **31.** A spring **37** bears against the outer collar **35** and urges the valve **33** into engagement with an internal seat **39** at the outer terminal portion of the nozzle **13.** Each of the other nozzles **12** through **19** is similarly constructed and held in place by similar retaining plates **27.**

The block **11** has a circular flange **41** which is secured to a vertical bracket **42** by bolts **43** or other similar fasteners. The bracket **42** is secured to a base plate **45.** The vertical bracket **42** has a central aperture **46** therethrough and integrally secured with the bracket **42** is a conduit **47** connecting the opening **46** with an opening **49** in the base plate **45.** As will be explained later, the base plate **45** is designed to be secured to the top of a high pressure pump so that fluid under pressure is forced through conduit **47.** The opening **46** through bracket **42** communicates with a circular cup-shaped recess **50** bounded by an annular flange **51** projecting inwardly from the vertical bracket **42.** This circular cup-shaped recess **50,** in turn, communicates with a smaller circular cup-shaped recess **52** in block **11.** The recess **52** has openings to eight passages leading to the eight nozzles **12–19.** The openings to passages **56, 57, 58** and **59** are shown in FIG. **1.** These passages lead to the nozzles **16, 17, 18** and **19,** respectively. The openings to two other passages **60** and **61** are shown in FIG. **4,** passages **60** and **61** communicating with nozzles **14** and **15.** A seventh passage is shown in FIG. **3** and designated by the reference numeral **62,** this passage going to nozzle **13.**

As will be explained in more detail later, when injection is taking place, fluid from the high pressure pump flows through the conduit **47** into the cup-shaped recesses **50** and **52.** From the recess **52,** the fluid flows through the various passages **56, 57, 58, 59, 60, 61** and **62** and an eighth recess, not shown, to the various nozzles **12–19.** The action can best be seen in connection with FIG. **3** in which nozzle **13** is shown in section. The fluid passes from recess **52** through passage **62** and into the space between the valve **33** and the bore **31.** Pressure builds up and exerts a pressure on the right-hand side of collar **34** tending to move the valve **33** to the left against the action of spring **37** which biases the valve **33** to a closed position by reason of spring **37** being compressed between the outer collar **35** and the inner face of bracket member **42.** When the pressure on the right-hand side of collar **34** builds up sufficiently to overcome the biasing force of spring **37,** fluid is immediately admitted past the valve seat **39** so that the end of the valve is now exposed to the pressure of the fluid. The area at the end of the valve (minus the area of the orifice passage **22**) is much greater than the area of the annular area of collar **34.** The result is that the effective pressure area for the fluid tending to open the valve is

suddenly increased and valve **33** is now moved abruptly to the left. By reason of this action, once the valve **33** starts to open, it moves with a snap action. The advantage of this is that the delivery of fluid is more sudden in character. No fluid is delivered until the pressure in the system builds up enough to open the valve with the fluid acting only on the limited area of collar **34.** Once it opens, however, it opens abruptly so that the fluid is very quickly discharged. It will also be noted that seat **39** against which a valve **33** bears is very close to the outer terminal portion of the nozzle **13.** It would be possible to have a single valve for all of the nozzles **12-19.** If this were done, however, no fluid would be delivered through the nozzle orifices after opening of the valve until all of the nozzles were filled; the fluid delivery would thus not be as abrupt. By placing the valve close to the end of each nozzle, once the valve is opened, the fluid is immediately delivered through the nozzle opening with no time delay or with no diminution of the pressure.

The flange **41** of block **11** is provided with an annular channel **65.** As best shown in FIG. **4,** this annular channel **65** communicates with two pipes **72** and **73** which are integrally joined to the bracket member **42** and communicate, respectively, with passages **74** and **75** therein. As indicated by arrows in passages **74** and **75,** the passage **74** is an inlet passage and the passage **75** is an outlet passage. The pipe **72** connected with passage **74** leads from a low pressure pump and the pipe **73** connected to outlet passage **75** is a return conduit leading back to a supply of the fluid additive. The annular passage **65** and the connections thereto provided by pipes **72** and **73** are for the purpose of enabling circulation of the fluid to be injected through the injector head **10** before injection takes place. As will be explained, it is often desirable to heat the fluid to be injected above the ambient temperature and by circulating the heated fluid around the annular passage **65,** the head **10** is maintained at a temperature close to the injecting temperature. This minimizes any tendency of the injecting fluid to cool off when it is introduced into the injector head **10** during the injecting operation.

In order to prevent leakage outwardly from the annular passage **65,** an O-ring **69** is provided. Similarly, an O-ring **70** is provided adjacent the flange **51** to prevent leakage out from the cup-shaped recesses **50** and **52** into which the high pressure injecting fluid is introduced.

In FIGS. **5, 6** and **7,** there is shown apparatus employing our novel injector head. This apparatus employs means for positioning the object being injected against the nozzles and for introducing fluid into the annular passage **65** and for introducing injecting fluid into the nozzles during the injecting operation. Referring first to FIG. **5,** the numeral **80** generally indicates a frame upon which the injecting apparatus is mounted. The injecting apparatus comprises a table **82** supported on a post **83** mounted in any suitable way on the frame **80.** Partially surrounding the table **82** is a platform **87.** This platform is supported by posts **88, 89,** and **90** and other posts (not shown). Secured to this platform **87** is the vertical bracket **42** to which the injection head **10** is secured. The nozzles **16** through **19** are shown as projecting from the injection head. To avoid an excessive number of reference characters in FIGS. **5** and **6,** only nozzles **12, 15, 16** and **19** have been specifically identified by reference numerals in these figures. As will be noted in FIGS. 1 and 2, in which a turkey 88 is shown as disposed on the table 82, the turkey is positioned on its back so that the lower portion of the breast is adjacent the uppermost of the nozzles 12 through 19.

It will also be noted that with the turkey 88 lying on its back, the longitudinal axis of the nozzles 12 through 19 is disposed at an angle of approximately 45° with respect to the front wall of the breast of the turkey. The pectoral muscles of the turkey tend to run generally parallel to the lower surface of the turkey (the upper surface in the drawing). The nozzles thus tend to be disposed at an angle of approximately 45° or less with respect to the pectoral muscles. It has been found that it is desirable that the fluid be injected at an angle of from 15° to 60° with respect to the general disposition of the pectoral muscles.

Disposed at the opposite end of the fowl 88 from the nozzle 12 through 19 is a posterior engaging member 90 shaped in the form of a frustum of a hollow pyramid which is shown as square in cross-section. In other words, the posterior engaging member has four sloping straight walls, all of which slope inwardly as they approach the rear of member 90. These walls are thus designed to engage and partially surround the posterior portion of the fowl 88 so as to hold it firmly against sidewise movement. Secured to the rear of the posterior engaging member 90 is a yoke 91 which is pivotally scured to a bar 92. This bar 92 is, in turn, pivotally secured at 93 to an ear 94 secured to the vertical post 83. Rigidly secured to the upper end of bar 92 is a handle member 95 which projects in the general direction of the injection head 10. It will be readily apparent that an operator standing to one side of the machine, by grasping handle 95, can pull the bar 92 forwardly about the pivot 93 and press the clamping member 90 into engagement with the turkey 88, moving the breast portion of the same against the nozzles 12 through 19. The nozzles 12–19 are disposed so as to engage the bird on opposite sides and aid in retaining the same against sidewise movement.

The means for supplying the liquid additive to the injector head 10 will now be described. The liquid additive is normally maintained in a tank 100 through which runs a heating coil 101. This heating coil is supplied with hot water from a suitable source 102 of hot water, there being a pmp 103 to circulate the water from the source 102 through the coil 101. It is, of course, to be understood that an ordinary domestic source of hot water may be employed for supplying the water to coil 101 in which case the normal pressure exerted on the water would make unnecessary the provision of a pump, such as pump 103. As a result of the heating coil 101, the additive is kept in a liquid state. One additive which is particularly desirable in the case of fowl is butter which is normally relatively solid at room temperatures. By heating it through the use of a heating coil, such as coil 101, the butter is maintained in a liquid state.

The supply pipe 47 of the injector head forms an integral extension of the outlet of a pump 108, the base plate 45 constituting the upper wall of the pump. The pump 108 is shown in section in FIG. 7. It will be noted that the pump has a piston 109 movable within a cylinder 110. The cylinder 110 is secured in fluid-tight relation to a fluid distributor block 11. The piston 109 is secured to a piston rod 112 which has a transverse passage 113 extending therethrough. Communicating with the transverse passage is a valve seat 114 against which seats a spring pressed valve 115. The fluid distributor block 111 has an inlet passage 117 and an outlet passage 118. A restrictor 119 is placed in the outlet passage. The inlet passage 117 communicates with the space beneath the piston 109 and is in communication with the transverse passage 113.

The inlet passage 117 is connected to a conduit 120 and the outlet passage 118 to a conduit 121. Secured to the distributor block 111 are the two conduits 72 and 73 previously referred to in connection with FIG. 4. Both conduits are secured to the block in fluid-tight relation, conduit 72 being in communication with the inlet passage 117 and conduit 73 in communication with the outlet passage 118 through the restrictor 119. A suitable seal 124 is provided in the block 61 to guard against loss of fluid around the piston rod 112. As was previously described, the vertical pipes 72 and 73 are connected to the annular passage 65 in the injector head 10. It will thus be apparent that fluid entering the inlet passage 117 can pass up through pipe 72, through the annular passage 65 of the injector head, out through passage 73, and back through the restrictor 119 to pipe 121.

Inlet pipe 120 connects with the outlet of a pump 129 operated by a hydraulic motor 129. The inlet of the pump 128 is connected through a pipe 127 to the interior of the tank 100 containing heated butter or other liquid additive. The pipe 127 preferably extends to a point adjacent the bottom of tank 100. Pipe 121 connected to the outlet of pump 108 is also connected to tank 100 and acts as a return line. Thus, when the pump is operating and no liquid is being injected into a fowl, the liquid flows from tank 100, through the pump 128, pipe 120, inlet passage 117 of pump 108, pipe 72, the annular passage 65 of injector head 10, pipe 73, the restrictor 119, and the return pipe 121 back to the tank 100. Thus, heated fluid is constantly circulated through the injector head 10 to maintain it at a proper temperature so that when liquid additive is introduced through pipe 47 for injection through the nozzles 12 through 19, the liquid additive will not be cooled upon being introduced into the injector head.

The hydraulic motor 129 is operated by a hydraulic fluid pump through two pipes 130 and 131, pipe 131 being the supply pipe and pipe 130 the return pipe. While we have shown hydraulic motor 129 schematically as a rotary motor, this is for purposes of illustration only and it is to be understood that any suitable hydraulic motor can be employed, such as a reciprocating piston type of motor. In this case, the pump 128 could be a reciprocating piston type of pump, such as pump 108.

Referring to the operation of pump 108, when piston rod 112 is moved upwardly, the valve 115 in the piston 109 is held closed by the spring engaging the same and by the downward pressure of the liquid. The liquid above the piston 109 is thus forced upwardly through pipe 47. At the same time, due to the fact that the valve 115 is closed, liquid additive supplied by pump 128 through pipe 120 flows in on the underside of the piston 109, filling the space in the cylinder beneath the piston 109. When the piston rod 112 moves downwardly, valve 115 is forced off of its seat and liquid beneath the piston 109 flows through the transverse passage 113 and past the valve 115 to the space above the piston 109. Thus, the space in the cylinder 110 above the piston 109 is refilled ready for the next upward movement of piston 109. Because of the restrictor 119 in the return line, there is always sufficient pressure in the inlet passage 117 to force valve 115 off of its seat as the piston 109 moves downwardly. It is to be understood that the pressure of the fluid flowing through pipe 47 is much higher than that supplied by pump 128. All that the pump 128 needs to do is to supply sufficient pressure to insure adequate circulation of the fluid through the head 10 and to provide an adequate supply of fluid for introduction into the pump 108 when it is being operated. The pump 108, on the other hand, must supply very high pressures. In actual practice, pressures from 600 to 1,000 pounds per square inch are employed in order to secure the very high pressure necessary to cause the injected liquid additive to pass through the skin of the fowl.

As has been described previously, the valves in the nozzles 12 through 19 open abruptly when the pressure supplied by pump 108 reaches the desired injecting pressure. Thus, the liquid additive is released suddenly through the nozzles.

The piston rod 112 of pump 108 is operated by a hydraulic motor 132 which is of the reciprocating piston type. Hydraulic fluid is supplied to one side of the piston by supply pipe 133 and at the other side of the piston by pipe 134. Piston rod 112 is moved upwardly by hydraulic motor 132 when it is desired to force fluid through pipe 47 into the injector head 10. When injection is completed, the piston is moved downwardly by the motor 132.

Reference has been made to hydraulic fluid flowing through pipes 130, 131, 133 and 134. The means for forcing hydraulic fluid flow through these pipes will now be described. Located on a platform extension 137 of the main frame 80 are two hydraulic pump units 135 and 136. Each of these pump units include a container filled with hydraulic fluid and a rotary hydraulic pump immersed in the fluid. The conduit 130 previously referred to is connected to the outlet of pump unit 135 and conduit 131 is connected to the inlet passage of the pump unit 135. Conduits 133 and 134 connected to the hydraulic cylinder 132 are connected to pump unit 136 which thus controls the operation of the hydraulic unit 132.

The pump units 135 and 136 are driven by electric motors 138 and 139, respectively. Located on the housings of pump units 135 and 136 are two accumulators 141 and 142, respectively. These accumulators serve to accumulate the hydraulic liquid under pressure and to deliver it to the hydraulic motors 129 and 132 in greater volume for a short period of time than would be possible if the liquid were supplied directly by the pumps driven by motors 138 and 139. Any suitable switching means may be provided to control the energization of motors 138 and 139.

It is desirable to adjust the amount of liquid injected by high pressure pump 108 through the nozzles 12 through 19 in accordance with the weight of the fowl. For this purpose, we have provided a switch 145. This is connected through conductors 146 and 147 to a solenoid valve 154 which controls the connection of conduit 133 from the pump unit 136 to hydraulic motor 132. The switch 145 is carried by a lever 149 pivoted at 150. The annular position of lever 149 and hence the vertical position of switch 145 is adjusted by a cam 151 which is secured through any suitable mechanical connection 152 to an arm 153 associated with a calibrated dial 144. The calibrations of dial 144 may, for example, be in terms of weight units representing possible weights of various fowl. After a fowl has been weighed or its weight estimated, a fowl is placed on the table 82 and the arm 153 is adjusted to assume a position corresponding to the weight of the turkey. It will be obvious that as arm 153 is adjusted in accordance with the weight of the bird being injected, the cam 151 is similarly adjusted to act on lever 149 to move the switch 145 up or down. Switch 145 is of the precision snap switch type having a button projecting downwardly therefrom. This button is designed to be engaged by a collar 162 secured to the piston rod 112. Obviously, as the hydraulic unit 132 moves the piston rod 112 upwardly to actuate piston 109 of the pump 108, the collar 162 will eventually engage the button of switch 145. When this happens, switch 145 is actuated to affect the energization of solenoid valve 154 to stop operation so that no more fluid is injected into the bird. While I have shown the switch 145 as controlling the amount of fluid delivered through the nozzles, it will be appreciated that any other suitable form of volume limiting transducer can be used.

The solenoid valve 154 may control the flow of hydraulic liquid through the hoses 133 and 134 in any suitable manner. For example, when the circuit including conductors 146 and 147 is interrupted by opening of switch 145, the solenoid valve 154 may be effective to interrupt the connection of conduit 133 to pump unit 136 and to connect conduit 133 to a return to the reservoir to permit the hydraulic fluid beneath the piston of hydraulic motor 82 to return to the reservoir.

The conduit 131 supplying fluid to pump 129 is connected to a second solenoid valve 155. The solenoid valve 155, when deenergized, is effective to terminate flow of hydraulic fluid through pipes 130 and 131 and pump 129 even though the motor 138 is running. For example, solenoid valve 155 may interrupt the supply of fluid to supply pipe 131 and bypass it to the reservoir in the container of the pump unit 135. Thus, solenoid valve 155, like solenoid valve 154, controls whether liquid is supplied to the hydraulic motor 132 associated therewith.

OPERATION OF THE INJECTOR HEAD OF FIGS. 1 TO 4

When it is desired to inject fowl, an adequate supply of the additive is placed in container 100 and the pumpe 103 is started to circulate hot water through the heat exchanger 101 to insure that the additive, such as butter, is in a liquid state before the injecting operation is to start. The proper switch buttons are actuated to start the motors 138 and 139 to, in turn, place into operation the pump units 135 and 136. A suitable switch button is operated to actuate the solenoid 155 to admit hydraulic fluid to the hose 131 and to interrupt its bypass connection with the reservoir. This causes a flow of hydraulic fluid through the hoses 130 and 131 to actuate the hydraulic motor 129 to, in turn, operate pump 128. This causes liquid additive to flow from the supply line 127 through pump 128, pipe 120, inlet passage 117 of pump 108, pipe 72, the annular passage 65 in injector head 10, pipe 73, restrictor 119 and pipe 121 back to the tank 100 containing the liquid additive. As soon as this has taken place for a sufficient period of time to cause the injector head 10 to be warmed up, it is now possible to inject liquid additive into a fowl.

A fowl is now placed on the able **82** with the back of the fowl resting on the table. After the weight of the bird has been determined either by estimating it or by weighing it, the arm **153** is adjusted to adjust the positionof switch **145** to adjust the amount of liquid additive to be introduced in accordance with the weight of the fowl. The handle **95** is now grasped and pulled forwardly to move the fowl **88** towards the nozzles **12** through **19** until the nozzles firmly engage the breast of the fowl. Solenoid valve **154** is now energized so as to admit fluid to conduit **133** and to interrupt its bypass connection with the reservoir. This causes operation of hydraulic motor **132** to force the piston rod **112** upwardly. The upper movement of piston rod **112** forces piston **109** of pump **108** upwardly to force fluid into the injector head under very high pressure such as, for example, from 600 to 1,000 pounds per square inch.

The fluid entering the injector head **10**, as previously explained, enters the recesses **50** and **52** through the various passages **57, 58, 59, 60, 61** and **63** and the passage (not shown) to the interiors of the nozzles **12** through **19**. As has been described in connection with the nozzle **13**, as shown in FIG. **3**, the pressure on the right-hand shoulder of the collar **34** will open the valve and as soon as this happens, the pressure face on which the pressure is acting increases abruptly to open the valve in the nozzle with a snap action. Because the valve action occurs at the end of the nozzle, the fluid is immediately released through the nozzle orifices. Thus, simultaneously, fluid is released at high pressure through all of the nozzles **12** through **19**. As has been previously explained, the orifice openings in the upper nozzles are somewhat larger than those in the lower nozzles so that a proportionally greater amount of fluid is introduced through the upper nozzles than through the lower nozzles. This is particularly important in connection with the injection of fowl where the fowl is placed on its back, as shown in FIG. **5**. Under these conditions, the nozzles **12** through **19** are pressing against the breast of the turkey and the upper nozzles **12, 13, 16** and **17** are pressing against the portion of the breast with a large amount of muscle tissue. It is hence desirable to introduce more fluid into these portions of the breast of the fowl. The disposition of the nozzles and the high pressure at which the additive is introduced causes the additive to penetrate the fowl through the skin without appreciably rupturing the same and causes the additive to penetrate through a substantial portion of the fowl. The angular disposition of the nozzles with respect to the pectoral muscles tends to cause the liquid additive to "splatter" within the fowl as it hits the various muscle walls. As soon as the piston has moved an amount corresponding to the desired injection of the fluid, the collar **162** engages the button of switch **145** to deenergize the solenoid valve **154**, interrupting the connection of pump **136** to line **133** and connecting this line to a bypass to the reservoir in the pump unit **136**. The injecting process is now completed and the handle **95** can be released and the turkey removed.

MODIFICATION OF FIGS. 8 TO 11

In the embodiment of the injector head shown in FIGS. **1** through **4**, the nozzle members were secured within a block and the standby circulation of injecting fluid was in an annular passage in the base of the block. In the modification of FIGS. **8** through **11**, the nozzle passages are formed as bores in a plurality of plates attached to the main block and the standby circulation is through these nozzle passages.

Referring first to FIG. **8** in which the injector head is shown in end elevation, looking directly at the nozzles, the nozzle passages are formed in two flat blocks or plates **160** and **161** secured to the sides of a central block **162**. The sides of the block **162** to which the nozzle blocks **160** and **161** are secured diverge away from each other extending from the top of the block to the bottom. Thus, the two rows of nozzle passages located in blocks **160** and **161** are likewise disposed so that they diverge outwardly proceeding from top to bottom. This is the same type of disposition of the nozzles as in the embodiment of FIGS. **1** through **4** in which separate nozzle tubes were employed. The blocks **160** and **161** are secured to the central block **162** by studs **164** or other suitable fastening means. The central block **162** is in turn held in position on a manifold block **165**.

The disposition of the nozzle blocks **160** and **161** on the central block **162** is also shown in FIG. **9** which is a top plan view of the injector head. It will be noted that the central block **162** is relatively short as compared with the nozzle block **160** and **161**. It will also be noted that the blocks **160** and **161** have their rear ends somewhat forward of the rear end of block **162**. Secured to the rear end of block **162** is a plate **167**. This plate **167** extends beyond the center block **162** to overlie the ends of blocks **160** and **161** in spaced relation thereto.

In FIG. **10**, the injector block is shown with a vertical section being taken through the center of the manifold block **165** and a central section through the nozzle block **160**, the section line being shown in FIG. **11** and designated by the numeral **10—10**. It will be noted from the section through block **160** that there are four nozzle passages **170, 171, 172** and **173**. In each of these nozzle passages, there is disposed a valve member. Since the valves in the uppermost passage **170** and the lowermost passage **173** are identical except for length, each is designated by the same reference character **174** and only one of these two valves will be described. Each valve **174** has a tapered outer end **175** which cooperates with a valve seat **176** immediately behind an orifice **177**. Towards the rear end of the valve there is a collar portion **178**. The outer diameter of the collar portion **178** is the same as the inner diameter of the nozzle passage so that the collar serves to slidably engage the interior of the wall of the nozzle passage. Spaced further to the rear of the nozzle passage is a further collar portion **179**. An O-ring is disposed in the groove between collar portions **178** and **179**. At the rear end of collar portion **179**, it is enlarged to form a collar **180** having a diameter substantially greater than that of the nozzle passage, the collar **180** being disposed behind the nozzle block **160** and between the nozzle block and the plate **167** previously referred to. A spring **182** surrounds the rear end of the valve member **174** engaging the rear wall of the collar **180**. The spring fits into a slight recess in the plate **167** and is compressed between plate **167** and a collar **182** so as to urge the valve **174** to the right into engagement with the valve seat **176**. One of the functions of plate **167** is to retain in position the springs **182** of the various valve members in the nozzle passages.

Orifice **177** of nozzle passage **170** has been referred to. The orifices of nozzle passages **171, 172** and **173** are respectively indicated by the reference numerals **185, 186** and **187.** These orifices are likewise visible in FIG. **8.** It will be noted that as with the species of FIGS. 1–4, the upper orifices **177** and **185** are larger than the lower orifices **186** and **187.** It will be appreciated that the same relationship exists between the upper and lower orifices in nozzle block **161.**

The outer portions of nozzle passages **170, 171, 172** and **173** are connected by a diagonal passage **190.** This may be formed by drilling a diagonal passage in the block **160** starting from the bottom of the block and closing the end with a plug **191.** As will be presently explained, the circulation of liquid prior to injection is accomplished by introducing liquid into the inner or left hand portion of nozzle passage **173** and circulating it through the nozzle passage **173,** the diagonal passage **190** and the nozzle passage **170** back to a return. The purpose of this is the same as the circulation of the heated liquid through annular passage **65** in the modifications of FIGS. **1** through **4.** In this connection, it will be noted in FIG. **10** that there is an opening **193** communicating with the left hand or inner portion of passage **173.** This passage **193** constitutes an inlet for the fluid and is connected through an internal channel in the central block **162** to an intake passage **195** extending centrally through the manifold block **165** and leading from the outlet of a high pressure pump shown schematically in FIG. **11** and designated by the reference numeral **196.** It will also be noted that there is an opening **194** at the left-hand end of nozzle passage **170.** This opening constitutes an outlet for the fluid being circulated through nozzle passages **173** and **170** as traced above. The outlet opening **194** communicates with a return pipe back to the supply of liquid, as will be presently explained.

It was noted above that the valves in nozzle passages **170** and **173** are identical except for length. The valves in intermediate passages **171** and **172** are different from those in the outermost passages in that in lieu of collars **178** at the rear of the valves, the similar collars are located near the forward end of the valves just behind the diagonal passage **190.** Referring specifically to the valve in passage **171,** this has been designated by the reference numeral **224.** Like valve **174,** it has an enlarged collar **180** at the rear which is engaged by a spring **182.** Unlike valve **174,** however, the valve **224** has a collar **228** near its forward end just behind diagonal passage **190.** This collar is spaced from a main enlarged portion of the valve sufficiently to permit the insertion of an O-ring **229.** By reason of the collar being just back of the diagonal passage **190,** fluid cannot enter the space between the major portion of valve **224** and the internal wall of bore **171.** This is for the purpose of reducing as much as possible the amount of fluid present between the valve and the chamber and hence to reduce any inertia or lag in the injection of the fluid. It is to be understood that the valve **224** in passage **172** is likewise spaced just back of the diagonal passage **190.** It is also to be understood that the valve in the nozzle passages in block **161** correspond to those just described in block **160.** In other words, the valves in the upper and lower nozzle passages of block **161** have their collars back toward the rear of the block while the valves in the intermediate passages have their

collars disposed near the front end of the valve just back of the diagonal passage in that block.

Before going further into the manner in which the fluid is circulated, the arrangement by which the central block **162** is attached to the manifold block **165** will be discussed. As shown in dotted lines in FIG. **8** and in section in FIG. **11,** the bottom of the central block **162** has a frustoconical projection **197** which fits into a corresponding recess in a gasket member **208** of some suitable plastic material such as polytetrafluoroethylene disposed in a counterbore in manifold block **165.** The block is held in place on the manifold by a pair of cap screws **203** extending centrally through the block **162** into the manifold block **165.** The frustoconical projection **197** is machined and cooperates with the gasket **208** to provide a high pressure seal when the cap screws **203** are tightened.

The manner in which the fluid is circulated through the nozzles prior to injection is best shown in FIG. **11.** In this case, the pump **196** corresponds generally to the pump **108** of FIG. **7** but is slightly different in the fluid distributor block beneath the pump. In order to enable a ready comparison of the pumps **108** and **196,** similar reference characters have been applied to corresponding elements which are similar in the two pumps. No attempt will be made to repeat the explanation of these elements. In the case of the present pump, the fluid distributor block **198** has a somewhat different configuration than the block **111** of pump **108.** In the case of block **198,** there is a single passage **199** which is connected to the inlet pipe **120** leading, as in connection with the previous embodiment, to pump **128.** Fluid entering this pipe **120** passes through the passage **199,** past the check valve **115** and into the passage **195** in the manifold block **165.** It will be understood that the manifold block is secured to the cylinder **110** of pump **196** by cap screws **200** or other similar fastening means. A suitable gasket is maintained between the members to prevent fluid leakage therebetween. From the passage **195,** fluid passes upwardly through a central passage **201** in the central block **162** and from there into a transverse passage **202** which extends completely across the block **162** communicating with the inlet openings **193** in the nozzle blocks **160** and **161.** There is a further transverse passage **204** in the upper portion of block **162.** This transverse passage connects with outlet openings **194** in the nozzle blocks **160** and **161.**

The upper transverse passage **204** connects with a passage **205** shown only in cross section in FIG. **11** but shown longitudinally in FIG. **9.** The inner end of this passage **205** is shown in FIG. **9** as communicating with transverse passage **202.** The passage **205** terminates at its outer end in a central chamber **206** in which is located a spool valve **207** having a central aperture **209** therethrough which communicates with the passage **205.** The spool valve **207** is biased against the right-hand end of the chamber **206** by a spring **210.** It is adapted when the pressure exerted on its right-hand face exceeds a predetermined value to move to the left against a fixed valve member **211** and to seal off the passage through the valve **207.** A suitable O-ring gasket **208** is provided in the outer wall of spool valve **207** to engage the wall of valve chamber **206** to prevent leakage past the valve when it is seated against the valve means **211.** A plurality of diagonal passages **213** are provided adjacent the valve member **211** and when the valve **207** is in the position shown, the fluid passing through passages **205** and **209** passes through the diagonal passages **213**. These passages communicate with a passage **214** in the end plate **167**. Secured to the end plate **167** is a sanitary pipe fitting **216** which is, in turn, coupled through any conventional type of coupling used in such sanitary fittings with the return pipe **121** returning to the tank **100**.

In normal operation, prior to the time that it is desired to inject fluid, the heated fluid from tank **100** is pumped by pump **128** through pipe **120** through the passage **199**, past the check valve **115**, through the passage **195** in block **165**, through transverse passage **202** to the openings **193** in blocks **160** and **161**. The two blocks are mirror images of each other and the operation in connection with block **160**, shown in FIG. **10**, is the same as that of block **161**. The fluid entering the inlet passage **193** passes through the nozzle passage **173**, as previously described, through the diagonal passage **190**, through the nozzle passage **170**, through the opening **194**, through the transverse passage **204**, through the longitudinal passage **205**, through passage **209** of the spool valve **207** and through the diagonal passages **213** and through opening **214** in plate **167** to the return pipe **121** which leads back to the tank **100**. It will be readily appreciated that this operation results in the circulation of heated fluid through the nozzle blocks themselves. This has the advantage over the arrangement of FIGS. **1** through **4** in that the heating is not confined to the base of the block but extends throughout the nozzle blocks. It will also be appreciated that the circulation just described results in the area above the piston **109** being filled with fluid and with all of the space between the valves **174** and the nozzle passages in blocks **165** and **161** being filled with fluid. Due, however, to the location of the collars **228** of valves **224** just behind the diagonal passage **190**, very little fluid is retained betwen the valves **224** of nozzle passages **171** and **172**.

Let it be assumed now that it is desired to inject and the necessary action is taken to cause operation of hydraulic motor **132** in the manner previously described in connection with the previous embodiment. The piston **109** is now moved upwardly to exert very high pressure on the fluid in the nozzle passages and to cause a large volume of fluid to flow. This will result in an increased pressure being exerted upon the right-hand side of the spool valve **207** tending to cause the latter to move to the left to engage the valve **211**. when this happens, flow of fluid through passage **209** is blocked and the pressure within the nozzle passages in the nozzle blocks **160** and **161** builds up rapidly. The pressure exerted by this fluid or collar **178** against the action of springs **182** results in the various valves **174** and **224** moving away from their seats. As soon as this happens, the pressure faces against which the fluid is working to open the valves increases abruptly so that the valves **174** and **224** move quickly away from their seats to cause an immediate release of the fluid through the nozzle **177**. The same action occurs almost simultaneously in connection with each of the nozzles so that there is an immediate release of the extremely high pressure fluid.

It will be seen that the modification of FIGS. **8** through **11** produces the same result of releasing the high pressure fluid abruptly. In the case of a fowl, this results in the liquid additive passing through the skin without appreciably rupturing the same. The arrangement of FIGS. **8** through **11** does have the advantage that its construction makes it much easier to comply with the desirable sanitary requirements. It will be noted that there is a minimum of area in which the injecting fluid stands prior to injection. The location of the collars **228** for the intermediate valves prevents fluid from entering the space between these valves and the nozzle passages. As for nozzle passages **170** and **173**, there is a constant circulation of fluid through these passages so that they tend to be self-scrubbing. Furthermore, it will be readily apparent that by removal of plate **167**, all of the valves in the various nozzle passages can be easily removed and cleaned. The entire nozzle can be readily disassembled for cleaning purposes. Thus, a high degree of sanitation can be readily obtained in connection with the nozzle block of FIGS. **8** through **11**.

CONCLUSION

It will be seen that we have provided a unique form of injector head for use with injecting apparatus in which the material is injected abruptly at very high pressures. It will also be seen that the injector head provides for circulation of injecting fluid while injection is not taking place so as to maintain the injector head at the desired injecting temperature. The injector head is particularly adapted for injecting meat and fowl, especially the latter; this is because of the shape and disposition of the nozzles. Furthermore, the injector head of the present invention is particularly adapted for use with meat or poultry where it is necessary to maintain a high degree of sanitation. While we have shown certain specific embodiments of the invention for the purposes of illustration, it is to be understood that the scope is to be limited solely by the appended claims.

We claim as our invention:

1. In apparatus for engaging a non-planar surface of an irregularly shaped object and injecting a fluid into the object:

an injector head for engaging the object and injecting fluid therein, said injector head having an inlet opening adapted to be connected to a source of fluid under pressure,

said injector head having a plurality of nozzle passages therein connected to said inlet opening and projecting outwardly varying distances from a plane substantially perpendicular to said passages so that the terminal portions of said nozzle passages approximately conform with the non-planar surface of the injected object engaged by the injector head,

valve means for preventing flow of fluid through said nozzle passages,

and means for maintaining said valve means closed until the pressure of the fluid reaches a predetermined value, said valve means being effective to open abruptly upon opening movement being initiated.

2. The apparatus of claim **1** in which the valve means consists of a plurality of valves, one for each of said nozzle passages, and in which each of said valves has a valving surface closely adjacent the terminal portion of the associated nozzle passage.

3. The apparatus of claim **1** in which the injector head has a passage connected to said inlet opening, and an outlet opening connected to said passage for circulating the fluid to be injected therethrough prior to the injection operation so that the injector head is maintained at a temperature approximately corresponding with the temperature of the fluid.

4. The apparatus of claim **3** in which the passage for circulation of fluid through said injector head is an annular passage located closely adjacent the inlet portion of the nozzle passage.

5. The apparatus of claim **3** in which the passage for circulating fluid to be injected prior to the injecting operation includes a plurality of such nozzle passages and in which valve means is provided for interrupting such circulation when the injection operation is to be initiated.

6. The apparatus of claim **5** in which said valve means for interrupting such circulation is pressure actuated and is responsive to the establishment of a pressure above a predetermined value to actuate said valve means to interrupt such circulation of fluid through the injector head.

7. The apparatus of claim **1** in which said nozzle passages are in the form of bores extending through a portion of said injector head.

8. The apparatus of claim **1** in which said nozzle passages are formed by nozzle members secured to and projecting from the injector head.

9. In apparatus for injecting a fluid additive into the flesh of a fowl to improve the eating qualitites thereof:

an injector head for engaging the breast of the fowl to inject fluid therein; said injector head having two rows of nozzle passages diverging downwardly away from each other, said nozzle passages of each row projecting outwardly progressively shorter distances, proceeding from one end of the row to the other, from a plane, substantially perpendicular to said passages so that the terminal portions of said passages approximately conform with the surface of the breast of a typical fowl; and

said injector head having an inlet opening adapted to be connected to a source of fluid additive under high pressure and said inlet opening communicating with each of said nozzle passages.

10. The apparatus of claim **9** in which the orifice through the terminal portion of the uppermost of said nozzle passages is greater than that through the lowermost of said nozzle passages so that a greater amount of fluid is injected in the portion of the breast of the fowl adjacent the upper nozzle.

11. The apparatus of claim **9** in which a valve is located in each of said nozzle passages with the valving surface of the valve closely adjacent the terminal portion of the nozzle passage so that the change in pressure upon the valve opening is immediately transferred to the fluid entering the object.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,814,007 Dated June 4, 1974

Inventor(s) Donovan H. Lumby, James T. Buerman, and James P. Korzenowski

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, Item [73], the name of the Assignee should be changed from "Land O'Lake Inc." to --Land O'Lakes, Inc.--Column 5, line 28, change "scured" to - secured - ; line 46, "pmp" should be - pump -; line 66, "block 11" should be - block 111 -. Column 6, line 25, the numeral "129" at the end of the line should be - 128 -. Column 9, line 3, "able 82" should be - table 82-. Column 13, line 35, the numeral "165" should be - 160 -.

Signed and sealed this 5th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents