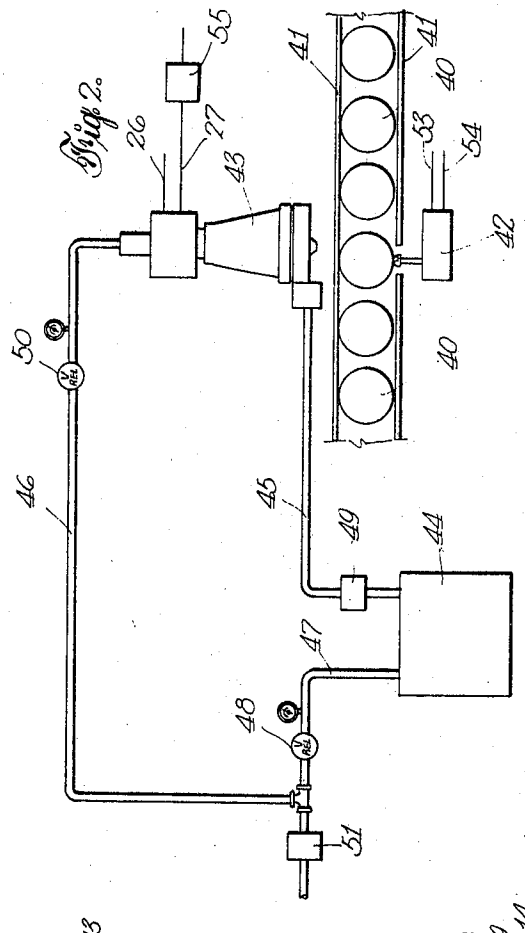
Dec. 9, 1969 J. VERKAIK 3,482,544

FLUID EJECTION APPARATUS

Filed July 24, 1967





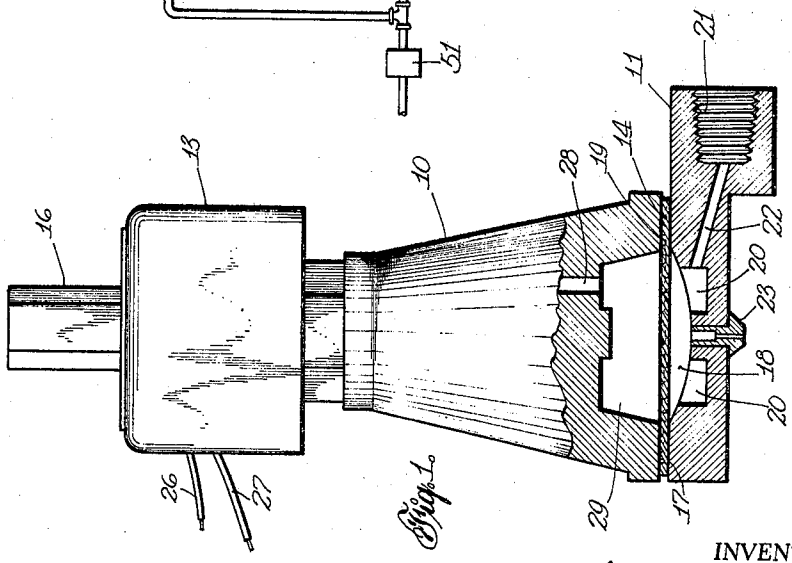


Fig. 1.

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United States Patent Office 3,482,544
Patented Dec. 9, 1969

3,482,544

FLUID EJECTION APPARATUS

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Filed July 24, 1967, Ser. No. 655,358
Int. Cl. B05c 5/02, 11/14
U.S. Cl. 118—2 14 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for ejecting predetermined amounts of fluid in rapid sequence including a nozzle adjacent to a conveyor. The nozzle is activated by the presence of the articles on the conveyor. The nozzle includes two chambers separated by a flexible diaphragm. Air is admitted by a solenoid valve to a chamber on one side of the diaphragm to cause said diaphragm to flex and eject fluid from a nozzle communicating with a chamber on the other side of the diaphragm.

BACKGROUND OF THE INVENTION

Field of the invention:

Fluid ejection apparatus for ejecting predetermined quantities of fluid to a predetermined location, the fluid ejected by the pulsing of a flexible diaphragm by pulses of pressurized air.

Summary of the invention

The present invention provides a means for marking, or otherwise treating, articles passing rapid sequence past a predetermined position. In particular it provides a simple, inexpensive apparatus for marking cans of food for processing. One of the difficulties experienced in canning foods is to ensure that all the cans treated reach the desired temperature during cooking and sterilization. Heretofore, it has not been possible to check that all cans reach the desired temperature. Previously, an operator stuck adhesive patches on isolated cans before cooking. The patches carried an indicator paint which changes colour when it reaches a certain temperature. If the patch on a can, or cans, of a batch changes colour, then it is assumed all the batch attained the desired temperature. Conversely, if the patch did not change colour, then it is assumed that all the batch did not attain the desired temperature.

This method is extremely wasteful as isolated cans with patches are not truly indicative of the conditions arising during cooking so far as the whole batch is concerned. Wastage is very high. However, until now, it has not been possible to mark each can with an indicator, at the speeds at which normal processing occurs in food canning. Normal spray guns are incapable of regularly controllable operation at the speeds required.

The present invention enables every can to be marked with temperature indicating paint and thus every can will be checked for having reached the necessary temperature.

There are many other manufacturing processes where articles pass a predetermined position for various activities, such as painting, marking for coding, and for the addition of predetermined amounts of a fluid to a container. The lack of a suitable ejector for the high speeds otherwise obtainable, means that the process is slowed down, or several of such predetermined positions provided to process several articles at once.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side view of one form of the ejection apparatus, with part shown in section,

FIGURE 2 is a diagrammatic illustration of one form of installation, for marking cans, and

FIGURE 3 is a cross-section through a nozzle illustrating a modification thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus illustrated in FIGURE 1 comprises two members, a first member **10** and a second member **11**. The first member **10** is in the form of a housing at one end of which is a solenoid valve indicated generally at **13**. The housing or member **10** has an annular surface **14** at the end remote from the valve **13**. An extension **16** provides for the connection of a pressurized air supply.

The second member **11** is in the form of a flat plate. An annular surface **17** is formed on the flat plate, or member **11**. A chamber **18** is formed in the plate. Gripped between the two annular surfaces **14** and **17** is a flexible diaphragm **19**, of impervious material. The diaphragm **19** defines a wall of the chamber **18**.

The chamber **18** is part spherical, and has two slots or grooves **20**, which act as reservoirs to the chamber **18**. At one end of plate or member **11** there is a screwed connection **21** for attachment of a supply line for fluid under pressure. A conduit **22** connects the connection **21** to one of the grooves **20**. A nozzle **23** is screwed into the member **11**, the bore **24** of the nozzle communicating with the chamber **18**.

The solenooid valve **13** is energized via leads **26** and **27**. Normally the solenoid of the valve holds the valve closed to prevent flow of pressurized air therethrough. Operation of the solenoid, via leads **26** and **27**, opens the valve for a predetermined period of time. This permits air to flow through a conduit **28** in the housing or member **10** and act on the side of the diaphragm **19** remote from the chamber **18**. To improve the actuation of the diaphragm **19**, a chamber **29** can be formed in member **10**.

The operation of the apparatus illustrated in FIGURE 1 is as follows. A supply of fluid to be ejected is connected to connection **21**. The fluid is pressurized and flows through conduit **22** into grooves **20** and chamber **18**. The bore of the nozzle **23** is of a size related to the viscosity and pressure of the fluid. The pressure of the fluid supply will depend to some degree on the viscosity of the fluid and will be somewhat less than the pressure of the air supply. Ideally the nozzle bore, pressure and viscosity are related so that fluid does not drip out of the nozzle, regardless of whether the nozzle is directed downwardly, upwardly or in any other direction.

The pressure of the fluid supply forces fluid into the chamber **18**, pushing up the diaphragm, holding it free of the nozzle **23**. On activation of the solenoid, a pulse of pressurized air is applied to the diaphragm **19** deflecting it into the chamber **18**. The length of the pulse can be varied and also the rate at which the air is supplied to the chamber **29**. Deflection of the diaphragm **19** increases the pressure in the chamber **18** very rapidly. The inertia of the fluid in the supply to the connection **21** resists return flow of fluid and thus fluid is ejected from the nozzle. Eventually the diaphragm closes off access to the nozzle, giving positive shut-off and sharp cut-off of fluid ejection. De-energization of the solenoid permits exhaust of the pressure air from chamber **29**, for a new cycle of operation. The range of operation is very wide, from 10 to 450 ejections per minute having been obtained. It is envisaged that with variation of the supply pressure, and probably also with less viscous fluids, such as vinegar, water and the like, higher rates of ejection will be obtained. Presently, the highest known speed of operation of a food canning line is believed to be in the region of 900 cans per minute. If such speeds

of operation of the ejector are required, it is possible to arrange for a number of ejectors, for example, three, to be provided and operated sequentially.

As has been stated, the uses of the ejector apparatus are numerous. FIGURE 2 illustrates diagrammatically the application of the ejector to the marking of cans for a canned food production line. The cans **40** move along a conveyor, **41**. In the present example, it is assumed that the cans have been filled and are to be passed to an oven for sterilization and cooking. As the cans pass along the conveyor, each can in turn contacts a micro switch **42**.

Adjacent the conveyor is positioned a paint ejector **43** of the form illustrated in FIGURE 1. Paint is supplied from a pressurized paint container **44** through pipe **45**. Pressurized air is supplied to the ejector **43** through pipe **46** and conveniently the same pressurized air source can be used for the supply of pressurized air to the ejector and to pressurize the paint container **44** through pipe **47**. A pressure control, and relief, valve **48** is fitted in the pipe **47** to provide the correct pressure, which will vary with paint viscosity and other parameters. A filter **49** is fitted in the pipe **45**.

A pressure control, and relief, valve **50** is fitted in the pipe **46** and an oil separator **51** is fitted in the main air supply line.

The micro switch **42** is in the circuit of the solenoid in the ejector **43**, having two leads, **53** and **54**. One of the leads, for example lead **53**, is connected to one of the leads of the solenoid, for example lead **27**. Leads **26** and **54** are then connected to a power source. To provide some control of the solenoid operation, an electronic control unit **55** is also in the circuit. The control unit **55** is of known construction and provides for controllably varying the characteristics of the solenoid such as varying the length of time the solenoid opens the valve in the ejector, and also the rate of operation of the solenoid.

In the particular arrangement of FIGURE 2, the paint which is applied to each can is a heat sensitive paint which changes colour when a predetermined temperature is attained. Thus, as each can is marked, it is possible to quickly and easily check each can to see that it attained the desired temperature during cooking. If desired, such checking can be done by electronic sorting apparatus, using an inspecting head sensitive to the colour of the paint on the can.

It will be appreciated that the opportunity of marking each can so that each can can be individually checked for correct heat treatment substantially reduces the wastage as only incorrectly heated cans are rejected. Furthermore, the marking and checking of cans is carried out at the normal speed of filling and conveying of the cans in the production line.

By varying the form of the nozzle of the ejector, or by using a plurality of ejectors, a predetermined pattern of spots can be applied to a can, or any other form of article. FIGURE 3 illustrates a modification to nozzle **23**, in which a plurality of bores **56** are provided to give a predetermined pattern of spots. The pattern can be used to provide a coding indicative of a date of manufacture, origin, batch number, contents or other desired information. The spots can be all in the same colour, or, with a plurality of ejectors, of differing colours. If the articles being marked are cans of food then the marking for coding purposes can be combined with the temperature checking. Various types of paints, or inks, can be used, and a further example is the use of special inks to provide for electronic sorting, using magnetic or other forms of ink.

Where several types of food are being canned, cans from several filling lines can be brought together to go through a common oven for heat treatment. It is possible to arrange that ejectors of the form of the present invention mark a ring of paint round the cans, the position of the rings relative to the ends varying for different foods. After heat treatment, the cans can readily be sorted as to contents. Electronic sorting can be used, detector heads being activated by the rings of paint. Again the paint can also be heat sensitive to combine the temperature checking feature as well.

By using suitable forms of nozzle, it is possible to use the ejector to paint articles passing along a conveyor in rapid sequence. An example is wheel rims, for automobile wheels. If the nozzle is formed to spray a hollow can or cone of paint, the passage of a wheel rim can be caused to actuate the solenoid valve in the ejector to apply a pulse of pressure air to the diaphragm. The wheel rim can be sprayed at one instant, providing a rapid and economical process.

Yet a further use of the invention is the adding of extracts, concentrates and the like to containers of food. A typical example is adding spice extracts to bottles of pickles. As the bottles pass along a conveyor, the ejector is activated, for example by a micro-switch and control as in FIGURE 2, and a predetermined amount of extract is ejected into the bottle. Very accurate and rapid treatment of bottles is possible.

Many other uses of the invention will be apparent. The unique form of ejector provides for the supply of accurately controlled quantities of fluid in extremely rapid sequence. The ejection is positive in cut-off, avoiding drips and erratic ejection. Therefore, the treatment of many forms of article by a fluid, or the application of a fluid to many forms of article, in rapid sequence, is available. It is also envisaged that the ejectors according to the present invention could be used to fill small containers, such as capsules holding small amounts of a compound. It will be appreciated that the diagrammatic installation illustrated in FIGURE 2 could be used for all the various alternatives, the form of conveying mechanism being varied to suit the particular article and the particular application, i.e., marking, painting, filling or other.

I claim:

1. Apparatus for ejecting a predetermined quantity of fluid to a predetermined location, comprising:

first and second members,

a surface on one member opposed to and cooperative with a surface on the other member,

an impermeable flexible diaphragm sealingly clamped between said surfaces,

a chamber in one of said members, a wall of the chamber defined at least in part by the diaphragm,

a conduit in said one member for the supply of fluid to the chamber,

a nozzle in said one member, in communication with said chamber,

a conduit in the other of said members for the supply of pressurized air to the side of the diaphragm remote from said chamber,

a valve for controlling the supply of pressurized air to the diaphragm, and

means controlling the operation of said valve to apply pulses of pressurized air to said diaphragm in rapid sequence to momentarily deflect the diaphragm into said chamber and eject a predetermined quantity of fluid from said chamber through said nozzle.

2. Apparatus as claimed in claim **1**, including a further chamber in the other of said members, a wall of the chamber defined at least in part by the diaphragm, the conduit in said other member supplying the pressurized air to said further chamber.

3. Apparatus as claimed in claim **1** wherein said valve comprises an electrically actuated solenoid valve.

4. Apparatus as claimed in claim **3** including a switch actuated by passage of articles at said predetermined location, the switch actuating said solenoid valve.

5. Apparatus as claimed in claim **4** including means for controllably varying the operating characteristics of the solenoid valve.

6. Apparatus as claimed in claim 1, further comprising conveyor means for conveying articles past said predetermined location in rapid sequence, passage of said articles actuating said means controlling the operation of said valve.

7. Apparatus as claimed in claim 6 including a pressurized supply of said fluid.

8. Apparatus as claimed in claim 1, wherein said nozzle comprises a plurality of bores, for the ejection of fluid in a predetermined pattern.

9. Apparatus as claimed in claim 1, including a plurality of nozzles in said one member.

10. Apparatus for marking cans of food passing in rapid sequence past a predetermined location, comprising; conveying means for carrying the cans past said location; a fluid ejector positioned adjacent said location, the ejector comprising a housing having an annular surface at one end, a valve in said housing, a member secured to said housing and having an annular surface for cooperation with the annular surface on said housing, an impermeable flexible diaphragm sealingly clamped between the annular surfaces, a chamber in said member, a wall of the chamber defined by said diaphragm, a nozzle in said member having at least one bore communicating with said chamber, a conduit in said member for the supply of a marking fluid thereto, and a further conduit in said housing for the supply of pressurized air to the side of the diaphragm remote from said chamber, said valve controlling the flow of air through said further conduit, a pressurized supply of marking fluid connected to said member; and means operated by the passage of the cans for actuating said valve to apply pulses of pressurized air to said diaphragm in synchronism with the passage of the cans to momentarily deflect the diaphragm into said chamber to eject a predetermined quantity of fluid from said chamber through said at least one bore.

11. Apparatus as claimed in claim 10, wherein said valve comprises an electric solenoid valve, said means operated by the passage of cans comprising a switch in the electric circuit of the solenoid.

12. Apparatus as claimed in claim 11 including control means for variably controlling the pulse-length and rate of operation of the valve.

13. Apparatus as claimed in claim 10, wherein said ejector includes a nozzle having a plurality of bores, for ejecting a plurality of jets of fluid in a predetermined pattern.

14. Apparatus as claimed in claim 10, wherein said ejector includes a plurality of nozzles.

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U.S. Cl. X.R.

239—330; 118—324