Feb. 26, 1957 E. H. BICKLEY 2,783,021

ELECTROMAGNETIC AIR PUFFER VALVE UNIT

Filed Dec. 11, 1952

Fig. 1.

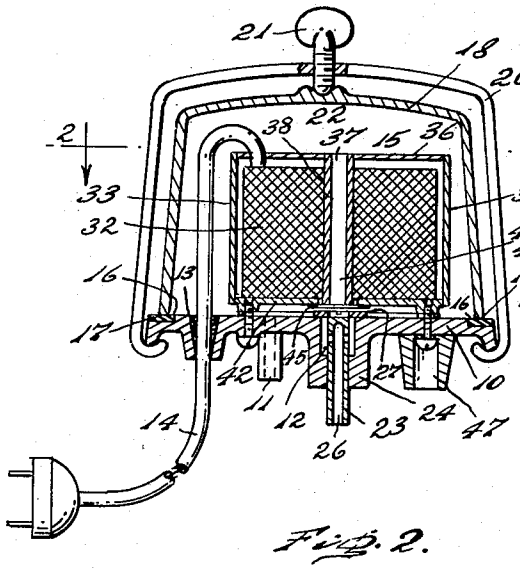


Fig. 3.

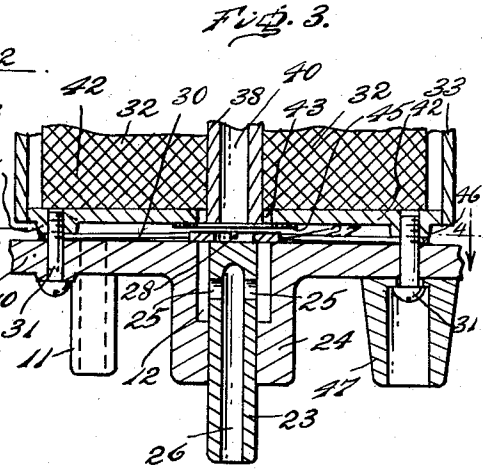


Fig. 2.

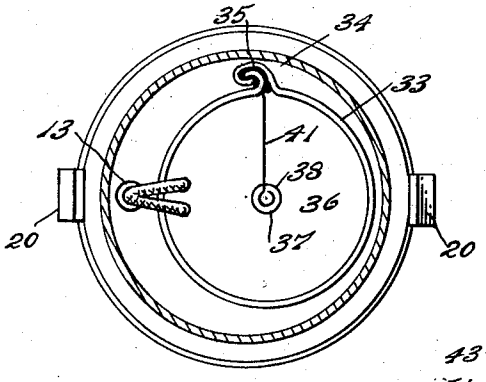


Fig. 4.

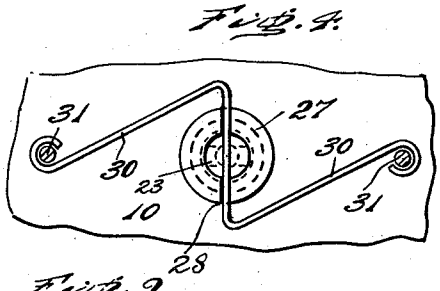


Fig. 9.

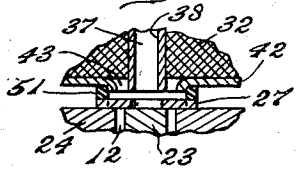


Fig. 7.

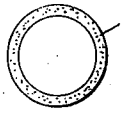


Fig. 5.

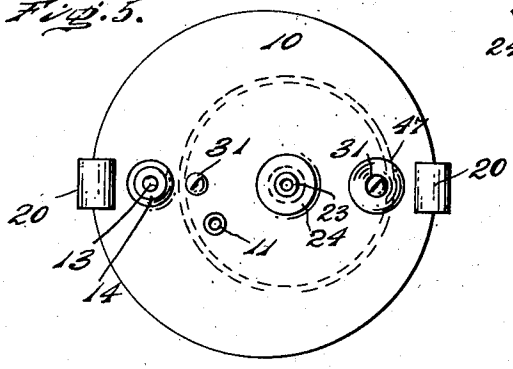


Fig. 8.

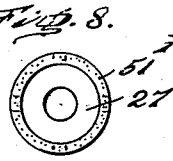
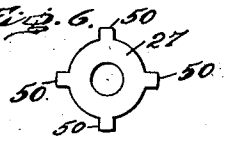


Fig. 6.



INVENTOR
Everett H. Bickley

BY
Robert M. Barr
ATTORNEY.

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ELECTROMAGNETIC AIR PUFFER VALVE UNIT

Everett H. Bickley, Narberth, Pa.

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3 Claims. (Cl. 251—140)

The present invention relates to air controlling valves and more particularly to a magnetically operated puffer valve unit for use as an essential part of a machine for color sorting of objects at extraordinary high speeds by short puffs of air emitted in rapid succession through the valve in response to selected color conditions. A machine of this character is shown in applicant's Patent No. 2,580,275, and with which the valve unit of the present invention can be used in place of the valve unit shown therein. Also, the invention is an improvement in some respects upon the magnetic valve shown in applicant's Patent No. 2,615,470.

An object of the invention is to provide an electromagnetic valve of improved construction for use in combination with the color sorting of beans, peas, coffee, rice, fruit, nuts, or other objects at high speed.

Another object is to provide an improved coil assembly which functions as a component part of a novel air control valve for releasing puffs of air in rapid succession to an outlet leading to a point adjacent an object inspection point in a color sorting machine.

Another object is to provide a fluid-controlling magnetic valve wherein the magnetic gap and the fluid outlet are alined in close proximity and at the point of maximum magnetic strength.

Still another object is to provide a high speed air puffer valve wherein inertia, friction, wear, magnetic and air losses are reduced to a minimum.

A further object is to provide a magnet coil which can be easily assembled and not only is protected from damage and corrosion when handling impure air, but also concentrates the magnetic lines of force in the armature substantially parallel to the direction of motion of air flow toward the outlet orifice.

Further objects will appear hereinafter in the specification.

In the accompanying drawings Fig. 1 represents a sectional elevation of a magnetic puffer valve unit embodying one form of the present invention; Fig. 2 represents a section on line 2—2 of Fig. 1; Fig. 3 represents an enlarged section of parts shown in Fig. 1; Fig. 4 represents a fragmentary section on line 4—4 of Fig. 3; Fig. 5 represents a bottom plan of the unit; Fig. 6 represents a plan of a modified form of armature valve; Fig. 7 represents a plan of a recoil washer for association with the armature valve of Fig. 6; Fig. 8 represents a plan of the armature and washer as assembled; and Fig. 9 represents a fragmentary section showing the modified form of armature valve with its recoil washer as assembled adjacent the outlet of the magnetic unit.

Referring to the drawings, one form of the present invention comprises a base 10, preferably circular in shape of aluminum alloy or brass material having an air inlet 11, a discharge passage 12, and a hole 13 for the passage of a two wire cable 14 to supply voltage to the control magnet 15 as will hereinafter be described. An outer circumferential offset 16 is provided in the upper

face of the base 10 to receive a gasket 17, against which the peripheral edge of an inverted bell housing 18 seats, to provide a leak-proof joint when the latter is fixed in place through the medium of a U-shaped clamp 20, which terminates in ends hooked about the base 10 to clamp the bell housing 18 in place by means of a thumb screw 21 threaded centrally through the clamp to bear against the top of housing 18. When the housing 18 is thus clamped to the base 10, it forms an air chamber or reservoir 22 which receives air under pressure by way of the aforesaid inlet 11. Discharge of air from the chamber 22 is by way of the air gap passage 12 in conjunction with a tubular outlet nozzle 23. This discharge construction forms one of the vital elements of the invention which contributes to a high speed result. As shown, the nozzle 23 is mounted axially of a boss 24 with its inner closed end within the discharge passage 12 and terminating in the plane of the upper face of the base 10. The diameter of the nozzle 23 is such that when assembled within the passage 12 it reduces that passage to a circular air gap outlet, which has such narrow cross-section as to approach the dimensions of a slit as to permit effective air discharge with very limited lifting of the valve. That portion of the outlet nozzle 23 within the passage 12 is provided with two ports 25 to lead the discharged air into the bore 26 of the nozzle 23.

For controlling the discharge of air to the circular passage 12, a valve 27 in the form of a magnetic responsive washer-like armature is provided and dimensioned to seat over the upper end of the passage 12 as a closure, while its center hole slightly overlaps inside the juxtaposed end of the outlet nozzle 23, and its outside slightly overlaps the outside of the bore 12. The upper face of the valve 27 in one construction is provided with a notch 28 which seats an elongated spring 30 so mounted as to bias the valve 27 to closed position. As shown, the ends of the spring 30 are respectively anchored to two mounting screws 31, the purpose of which will appear later herein. The spring 30 not only holds the valve on the seat, but also positions the valve 27 so that it remains in the proper position to fully close the circular air slit when seated. The air pressure within the unit acts also to return the valve to its seat as an auxiliary aid should there be any relaxing of the spring. Instead of this spring 30 a rubber washer may be used, as is described below.

In order to open the valve 27 against the bias of the spring 30 and the air pressure inside the chamber, an electromagnet is provided comprising a ring coil 32 and a surrounding magnetic core, preferably steel, which together form an entirely new assembly for a maximum magnetic focus at the valve air gap with consequent rapid sensitive action. The steel core is formed by a steel band 33 encircling the side of coil 32 as a protecting enclosure, such band may be in the form of a tube for telescoping about the coil, but is preferably a band length terminating in an interlocking hook joint, as shown at 34. Preferably this joint includes a strip of insulating fibre 35 to stop eddy currents. The band 33 is closed at the top by a steel or like magnetic metal plate 36 welded or otherwise made fast to the band and having a central aperture 37 in axial alinement with the central hole of the coil 32. The side of this coil hole is protected by a tube 38 of steel attached at its upper end to the plate 36 with its bore 40 registering with the aperture 37 in the plate 36. The bore 40 provides a passage for air to discharge into close proximity to the valve 27. The length of the tube 38 is such that its lower end protrudes below the coil 32 to form a relatively small air gap with the valve 27. Preferably the tube 38 is slit lengthwise to stop eddy currents, and this slit communicates with a radial slit 41 in the plate 36 for the same purpose. Both

slits are very fine and may be filled with insulating material.

The lower end of the coil **32** is protected by a plate **42** marginally attached to the band **33**, by welding or otherwise, and has a central hole encircling the protruding end of the tube **38** in spaced relation to form a magnetic air gap **43** in register with the valve **27**, such gap **43** being of slit-like dimension. The plate **42**, like the top plate **36**, is formed with a like fine radial slit to stop eddy currents. Preferably, a paper washer **45** is disposed between the valve **27** and the plate **42** and encircles the said magnetic gap **43** to prevent residual magnetism from causing the valve to stick. While the magnet core has been described as individual parts, interconnected, the core is actually a complete unitary member enclosing the coils externally and internally except for the magnetic gap **43** in the bottom plate **42**.

For mounting the coil **32** with its associated band parts, the lower face of the plate **42** is provided with internally threaded bosses **46** to receive the mounting screws **31** which pass through the base **10** for clamping purposes. One such screw **31** also serves to attach a mounting socket **47** by which the whole assembly is supported conveniently with respect to the sorting machine's inspection point. The cable **14** forms an energizing circuit for the coil **32** in accordance with signals received from the signal equipment. The signal equipment includes a control circuit including one or more thermionic tubes and a photo-electric cell, which latter controls the input of the tube or tubes, as it scans a succession of beams travelling in rapid row succession past the inspection point where the discharge nozzle from the puffer air outlet is located, to segregate beans of like color into one of two receptacles.

With beans travelling at a high rate of speed, it is obvious that the valve must operate instantaneously. By the present invention the lift of the valve may be very small in amount but this alone will not contribute to the instantaneous action necessary unless the magnetic air gap and discharge air gap in conjunction with the focussed maximum magnetic force developed by the novel coil assembly cooperate as a combination to produce the new result.

Particular attention is directed to the spacing of the armature valve **27** with respect to the electromagnetic air discharge outlet because the juxtaposed relation of these parts forms an air gap of very small proportions. When the valve opens there are two air discharge paths; the hole of the armature on the inside, and the other from the outside of the armature, peripherally.

In the form of the invention shown in Figs. 6 to 9 the armature valve **27** is also in the form of a washer dimensioned to control the passage **12** but is provided with radially projecting ears **50** to the top surface of which an elastic washer **51**, preferably rubber, is cemented to function as a means to bias the valve to closed position. When assembled as shown in Fig. 9 the washer **51** seats against the lower face of the plate **42** and is held against lateral displacement by outwardly flaring the peripheral edge of the air gap **43** so that it enters the hole in the washer **51**. As so assembled the rubber washer **51** encircles the annular flaring and the plate in contact relation maintaining the valve **27** accurately in register with the passage **12**. A lift of the valve by energization of the coil opens the valve **27** and compresses the washer **51** so that when the coil is deenergized the washer **51** recoils

to close the valve. It is desirable to have the valve open and close at about the same flow of current in the coil. Since the magnetic attraction increases very rapidly as the armature approaches the pole pieces, hence when the rubber is compressed, the resistance runs up very fast in practically matching relation to the flow of current.

The ultimate result of the conjoint action of the washer type armature, the narrow circular discharge passage, and the associated similar air gap, makes it possible to produce a valve lift of very small proportions whereby the puffs of air can be discharged in rapid succession and at a speed heretofore unapproached by any previous valve for sorting beans at rates commercially demanded.

Having thus described my invention, I claim:

1. An air puffer unit to produce short puffs of air at extremely high speed for association with a machine for color sorting of objects comprising a base, an inverted bell housing formed with said base a sealed air reservoir, an air inlet through said base leading to said chamber, an air outlet through said base, a tubular nozzle mounted in said outlet to form a slit-like concentric discharge passage encircling said nozzle, said nozzle having a port communicating with said passage, a valve in the form of a washer of magnetic material positioned to control said concentric passage, means biasing said washer to closed position, an electro-magnet, to lift said valve to open said passage to release air from said chamber, said magnet providing a gap in close proximity to said valve and at the area of maximum magnetic field.

2. An air puffer unit in accordance with claim 1 wherein the electromagnet comprises a ring coil and a core of magnetic material about said coil having a central hole axially alined with the passage for discharge of air into said passage when the valve is open, said core also forming a magnetic air gap encircling an end of said hole in close proximity to said air discharge gap.

3. An air puffer unit to produce extremely rapid short puffs of air for association with color sorting mechanism, comprising the combination of a magnet coil, a core of magnetic material enclosing said coil and forming an axially disposed air passage and an annular magnetic gap encircling one end of said passage, a housing for said coil forming a sealed chamber having an inlet for air under pressure and a cylindrical outlet communicating with said gap and axially alined with said passage, a tubular nozzle having a closed end terminating in said outlet and having a lateral port communicating with said outlet, an armature disc valve seating over said outlet having an aperture alined with said passage, said valve opening said outlet when said coil is energized, and means for restoring said valve to closed position when said coil is deenergized.

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