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(54) Title: IMPROVED DISPENSING APPARATUS

(57) Abstract

Dispensing mechanism (10) includes a plurality of storage containers (12), each container having two or more metering pumps (46, 48) associated therewith. The containers and metering pumps are located on a turntable (14) which is indexed to move a particular metering pump to a dispensing station. Automated dispensing equipment (70) operates the metering pump at the dispensing station and the turntable is thereafter indexed a smaller amount to bring the other pump associated with the same container into a dispensing position. In this manner, a single actuator system can be employed for multiple discharge cycles associated with a particular canister, and can accommodate multiple canisters.
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IMPROVED DISPENSING APPARATUS

Background of the Invention

1. Field of the Invention:
The present invention pertains to dispensing apparatus for liquid and pulverulent materials, and more particularly to such apparatus which is suitable for automated operation.

2. Description of the Related Art:
Automated dispensing apparatus for pulverulent materials, such as food flavorings, chemical additives, paints, paint colorants and inks, for example, are becoming increasingly popular. Automatic dispensing machines have been developed for dispensing a plurality of different materials into a common container. These systems typically employ separate independent sources of material to be dispensed, with individual discharge mechanisms associated with their respective materials.

Examples of such apparatus are disclosed in commonly assigned United States Letters Patent Nos. 4,967,938 and 5,078,302. Formulations are stored in a digital computer or similar control device. Valve operating and pump operating equipment is provided at a dispensing station, located at a point adjacent a turntable carrying containers which hold the different materials. The valve operating and pump operating equipment is coupled to the computer. An operator selects a particular formula (e.g., by name) from a list of formulas stored in the computer. When the formulation is identified, the computer indicates the first canister to be selected. For example, when the material being dispensed is a coloring, such as a tint
for a paint base, the computer identifies which color
tint is to be dispensed first.

The container may simply be identified on an
output device, such as a cathode ray tube, with the
system pausing until confirmation by the operator that
the particular canister is in the desired position, or
alternatively, the control system may index the
turntable automatically, to bring the canister to the
dispensing station. An example of a semi-automatic
dispensing apparatus in which the turntable is manually
indexed by an operator is described in commonly
When the container is in place, the computer then
directs the valve operator to open necessary valves for
a dispensing operation and to prepare the pump operator
for a pumping stroke. Under computer control, the pump
associated with each container is operated so as to
discharge an amount called for by the selected formula.
After the pumping operation is completed, the computer
calls for closing of the necessary valves, and the
cycle is repeated for a second container (e.g., a
second color tint to be added to the paint base). As
with the fully automatic systems, the valve operation
5,119,973 is under computer control.

In each of the above-mentioned United States
Letters Patent, a single dispensing pump is associated
with each storage container. Commonly assigned United
States Letters Patent No. 4,027,785 discloses a dual
pump colorant dispenser offering improved metering
accuracy, with a large pump dispensing large quantities
of material, and a small pump dispensing small
quantities of material so as to more accurately achieve
a total dispensed amount. However, the dual pump
dispenser has been developed for and has found ready
commercial acceptance as a manually operated device.
Improvements are still being sought in automatic dispensing equipment, and it would be desirable to provide improved metering accuracy with a minimum of development time and cost of production.

5 Summary of the Invention
It is an object according to the present invention to provide automated dispensing apparatus having improved dispensing accuracy.

Another object of the present invention is to provide apparatus for dispensing a plurality of different materials into a common receptacle.

Yet another object according to principles of the present invention is to provide automated dispensing apparatus having dual pump dispensers for the various materials being dispensed.

These and other objects according to principles of the present, which will become apparent from studying the appended description and drawings, are provided in apparatus for dispensing a target amount of a material to a receptacle, comprising:

at least one material source for holding the material to be dispensed;

at least two discharge means coupled to said at least one material source and operable by an actuator means, for discharging from said at least one material source, preselected different amounts of material, each less than said target amount;

actuator means for actuating said discharge means in response to a command signal;

movable support means carrying said discharge means to and from said actuator means;

drive means for moving said movable support means so as to carry preselected ones of said discharge means to said actuator means in response to a drive signal;
control means coupled to said actuator means for sending said command signal thereto and further coupled to said drive means for sending said drive signal thereto, said control means operable to send a first drive signal to said drive means so as to carry one of said discharge means to said actuator means and so as to send a first command signal to discharge a first preselected amount of material, less than said target amount, therefrom and to thereafter send a second drive signal to said drive means so as to move said movable support means so as to carry the other of said discharge means to said actuator means and so as to send a second command signal to said to discharge a different preselected amount of material, less than said target amount, therefrom so that the amounts of material dispensed combine to achieve the target amount with an improved accuracy.

**Brief Description of the Drawings**

FIG. 1 is a perspective view of dispensing apparatus according to principles of the present invention;

FIG. 2 is a fragmentary top plan view thereof; and

FIGS. 3-17 are fragmentary front elevational and side elevational views thereof, showing a sequence of operation.

**Detailed Description of the Preferred Embodiment**

FIG. 1 shows dispensing apparatus according to principles of the present invention, wherein a plurality of storage containers or canisters 12 are mounted on a turntable 14, which rotates in the direction of double-headed arrow 16. A stationary dispensing station generally indicated at 20 includes
automated pump and valve actuators under control of a
digital microcomputer, analog circuitry, or other
control device 22.

Referring additionally to FIG. 2, the control
device 22 is also coupled through conductors 24 to a
drive motor 26 having an output shaft 28. The motor 26
drives the shaft 28 in opposite directions, as
indicated by double-headed arrow 30. A gear 32
attached to the output shaft 28 engages a gear ring 36
which is attached to turntable 14. By sending drive
signals to motor 26, the control device 22 causes the
output shaft, and hence gear 32, to rotate in opposite
directions, indicated by arrow 30. This, in turn,
causes turntable 14 to rotate in the directions
indicated by arrow 16 in FIG. 1. The control system 22
indexes turntable 14 to present a particular canister
to the dispensing station 29, as called for in a
program stored in the control device. In the preferred
embodiment, the control device 22 comprises a digital
microcomputer, and the program referred to herein is
preferably stored on a floppy disk and installed in the
microcomputer to be called on demand by an operator.
In the preferred embodiment, the operator is given a
menu choice of different formulations to be dispensed.

The dispensing apparatus of the present
invention has found ready commercial acceptance in the
paint industry, and has been directed to dispensing
different colored tint materials into a container 40 of
paint base material (see FIG. 1). The control device
22 presents a menu of final paint colors to an
operator, who selects the desired color. The control
device then calls up the formulation associated with
the paint color, and calls for the dispensing of the
required paint tints stored in canisters 12, one
canister at a time.
The control device identifies and calls for a first canister to be brought to the dispensing station 20. Drive signals are sent through conductors 24 to turntable drive motor 26, which indexes turntable 14 as required to bring a particular canister to the dispense station. Automated devices, to be explained herein, automatically dispense a desired quantity of material from the canister into the receptacle or container 40, and the program identifies the next colorant to be added to the container. The control device then sends drive signals to motor 26 to index the turntable 14 to present a second desired canister to the dispensing station 20. The dispensing cycle is then repeated with the turntable being indexed the required number of times until all of the different paint tints are dispensed into the container 40. The container (with its paint base and paint tint material) is then sealed and mixed to provide the desired paint color in the amount indicated by the operator of the dispensing apparatus.

As will be seen herein, improved dispensing accuracy is provided with dual pumps associated with each canister 12. Referring to FIG. 4, for example, a typical canister 12 has associated therewith a discharge system, generally indicated at 44, which includes a larger metering pump 46 and a smaller metering pump 48, each coupled to the same canister 12. The metering pumps are mounted in a valve block 50 containing valve mechanisms for controlling the flow of metered material. A handle 52 is mounted for rotation about a shaft 54. When rotated, the handle 52 opens and closes a path of travel for the dispensed material, allowing the material to flow to a position below the valve block 50.

The pumps 46, 48 include shafts 56, 58 which reciprocate in the direction of double-headed arrows 60
so as to suction and to eject under pressure, desired quantities of materials stored in canister 12. The amount of the material dispensed by the metering pumps depends upon the amount of travel of the shafts 56, 58, respectively, and automated equipment is provided for reciprocation of the pump shafts in the amount required to achieve a desired discharge volume.

Referring again to FIG. 4, an actuator system generally indicated at 70 is mounted in a stationary position at the dispensing station 20. The actuator system 70 includes a first drive motor 72 coupled through conductors 74 to control device 22. The drive motor 72 drives rods 80, 82 in vertical directions, moving the valve engagement tool 84 between the two operating positions shown in FIG. 5 and FIG. 17, associated with closed and open valve positions, respectively. The actuator system 70 further includes a pump actuator motor 88 coupled through conductors 90 to control system 22. Motor 88 drives cog belt 92, so as to raise and lower pump operator tool 94.

As shown in FIGS. 3 and 5, for example, the pump operator tool 94 includes a pair of vertically spaced rollers 96, 98, which are free to rotate about their respective mounting shafts, which extend in generally horizontal directions. A gap or nip 100 is formed between the rollers 96, 98. Referring again to FIG. 4, washers 104, 106 are secured to shafts 56, 58, respectively, and are secured thereto with nut fasteners. As turntable 14 is rotated, washers 104, 106 pass through the nip 100 and, as will be seen, when a desired canister is located in position at the dispensing station, either washer 104 or washer 106 will be received in the nip 100, held captive between the rollers 96, 98. With reciprocation of the cog belt 92, the rollers 96, 98 and the washer held captive therebetween are raised and lowered, upon the issuance
of command signals to pump actuator motor 88. This in
turn reciprocates the piston rods 56, 58 of the
metering pumps.

Referring to FIG. 4, turntable 14 is being
rotated in the direction of arrow 110 so as to bring
the cylinder 12 and its related dual pumps into
position at the dispensing station, the centerline of
which is indicated by reference line 114, a line
passing through the central plane of the valve and pump
operator tools. According to one aspect of the present
invention, the cylinder 12 is advanced to the
dispensing station such that one or the other of its
differently sized pumps are aligned with the valve and
pump operator tools. As indicated in FIG. 4, reference
line 116 is located at the center of the larger
metering pump 46, and turntable 14 is advanced until
the reference line 116 is located at the reference line
114, with the larger metering pump 46 being located in
the desired operating position at the dispense station.

As contemplated herein, the operating position of the
cylinder and its related equipment is one in which the
valve handle 52 is located within the recess 120 of
valve operator tool 84 and with washer 104 located in
the nip between rollers 96, 98. FIGS. 6 and 7 also
show the larger metering pump 46 in operating position
at the metering station.

Next, the valve operator tool 84 is lowered
in the direction of arrow 124 to the position
illustrated in FIG. 17, for example. This action opens
the valving within valve block 50 and clears a
passageway for discharge of colorant material, in the
direction of arrow 128 shown in FIG. 9. To achieve a
discharge of material, positive and negative pressures
are developed in the metering pump 46 which forces
material in container 12 into and out of metering pump
46 through a discharge nozzle to exit the valve block.
50, as shown by arrow 128. As shown in FIGS. 3-7, for example, the pump pistons 56, 58 are fully depressed, with the metered volume in each pump being nil.

As indicated in FIG. 8, the drive motor 88 has been energized so as to raise the pump operating tool 94, thereby raising the washer 104 attached to metering pump rod 56. This raises the plunger within the metering pump, filling the pump with a predetermined metered volume, proportional to the height of washer 104. Referring to FIGS. 10 and 11, the command signals to drive motor 88 are changed so as to cause a downward displacement of the pump operator tool 94, emptying the metered contents of pump 46. Thus, a first, larger quantity of material is dispensed with a complete cycle of operation of pump 46.

According to one aspect of the present invention, the full desired ("target") amount of material is not dispensed with operation of pump 46, but requires a cycle of operation of the smaller metering pump 48. If desired, in some applications, operation of smaller pump 48 can be omitted and a canister containing a different colorant material can be moved to the dispensing station. However, in many dispensing operations, the metering accuracy requires that at least a small amount of material be dispensed by the smaller metering pump 48. Accordingly, referring to FIG. 12, turntable 14 is rotated a relatively slight amount, as indicated by arrow 140, so as to bring the smaller metering pump 48 into an operating position at the dispensing station, with washer 106 held captive between the rollers 96 and 98, and with handle 52 received in the recess 120 of valve operator tool 84.

A second pump operating cycle similar to that described above with reference to FIGS. 8-11 is repeated in the manner indicated in FIGS. 14-17 to
discharge a metered amount of material from the smaller metering pump 48. FIGS. 14 and 15 show the raising of the pump operator tool 94 so as to suction material from valve block 50 from canister 12, filling the metered chamber within pump 48. Command signals to drive motor 88 are reversed, and pump piston 58 is lowered to discharge the metered amount of materials through the valve block. FIG. 17 shows the handle 52 depressed so as to open the discharge passageways through valve block 50. Upon conclusion of the pumping cycle, command signals are sent to drive motor 72, raising the valve operator tool 84 and closing the valving with valve block 50.

The actuator system described above is the same as that shown and described in United States Letters Patent 5,119,973, the disclosure of which is herein incorporated by reference as if fully set forth herein. An example of the control system is also given in this patent, with the notable exception that the present invention is directed to dual metering pumps whereas United States Letters Patent No. 5,119,973 is concerned only with a single metering pump associated with each canister. Other examples of actuator systems are shown in United States Letters Patent Nos. 4,967,938 and 5,078,302, also commonly assigned, and the disclosures thereof are also incorporated by reference herein as if fully set forth herein.

Details concerning the operation of the dual metering pumps and of the valve block 50 may be found in commonly assigned United States Letters Patent No. 4,027,785, the disclosure of which is incorporated herein as if fully set forth herein. One notable difference is that the dual pumps of the patent are manually actuated, although other details concerning the operation of the dual pump colorant dispenser are present in the preferred embodiment of the present
invention. As will now be appreciated, the present invention can be readily practiced in a commercial environment using a number of existing, proven systems which do not require extended evaluation efforts.

Referring again to FIG. 2, the reference arrows 112, 140 of FIGS. 4, 12, respectively, are shown to indicate a sequence of operation associated with a first canister 12a. To complete a dual pumping cycle for the metering pumps associated with canister 12a, the direction of rotation of turntable 14 is reversed to bring the smaller metering pump 48 into position along a reference line 152. Other variations are, of course, possible. For example, the relative locations of the larger and smaller metering pumps 46, 48, can be reversed if it is desired to discharge the smaller metered amount using the operating pattern indicated by arrows 112, 140.

As a further alternative, the sequence of operation can be altered, with turntable 14 being rotated as indicated by reference arrow 160 to bring the smaller metering pump 48 into position at a reference line 164. After the dispensing operation is completed, the turntable 14 is advanced in the same rotational direction, as indicated by reference arrow 166, to bring the larger metering pump into position at the reference line 164. It is assumed, in providing a practical operating mode, that reference line 164 will be made to correspond to the reference line of a dispensing station, e.g., the reference line 146 shown in FIG. 4. Again, if desired, the larger and smaller metering pumps can be reversed.

As can be seen from FIG. 2, the metering pumps associated with a particular canister are spaced much closer to each other, than the spacing between adjacent canisters. Thus, operation in a complete
dispensing cycle usually involves indexing the
turntable 14 with a first, larger rotational
displacement to bring a first metering pump into
position at a dispensing station, and then a much
smaller rotational displacement to bring the second
meter pump associated with the same canister into
position at the dispensing station. Put another way,
it is preferred that the canisters are spaced apart on
turntable 14 with a certain preselected minimum
spacing, and with the metering pumps associated with a
particular canister being spaced from each other with a
much smaller spacing. This results in a minimal
disturbance of the relative alignment between moving
and stationary parts for a discharge associated with a
particular canister. Thus, the accuracy of the metered
dispensing of the multiple metering pumps associated
with a particular canister are held to very low
tolerances, an important factor for newer painting
formulations which require more concentrated tinting
materials which much be dispensed in smaller-than-usual
quantities. Although the relatively large rotational
displacements associated with bringing a different
canister into position at a dispensing station cannot
be avoided, optimization of the metering accuracy
associated with a particular canister is maintained at
a high level.

Other alternatives are also possible. For
example, a rotating turntable has been described above.
However, it should be understood that the present
invention also pertains to arcuate and linear
reciprocating tables which carry the canisters and
metering pumps described above, and wherein full
rotations of the table are not required. Further, the
source of material, i.e., the canisters 12, are
described above as being carried along adjacent the
pairs of metering pumps, it is possible, especially
with non-rotating tables, that the canisters are remotely located from the metering pumps and may even be fixed in position, being coupled, for example, with flexible tubing to their associated metering pumps. These latter arrangements can be conveniently provided with tables which reciprocate in a linear or in arcuate fashion. Further, although the canisters and metering pumps have been described as being mounted on a horizontally extending turntable, it is possible that the equipment can also be located on a vertical "table" which is displaced in vertical direction to bring the various metering pumps to a dispensing station.

The drawings and the foregoing descriptions are not intended to represent the only forms of the invention in regard to the details of its construction and manner of operation. Changes in form and in the proportion of parts, as well as the substitution of equivalents, are contemplated as circumstances may suggest or render expedient; and although specific terms have been employed, they are intended in a generic and descriptive sense only and not for the purposes of limitation, the scope of the invention being delineated by the following claims.
WHAT IS CLAIMED IS:

1. Apparatus for dispensing a target amount of a material to a receptacle, comprising:
   at least one material source for holding the material to be dispensed;
   at least two discharge means coupled to said at least one material source and operable by an actuator means, for discharging from said at least one material source, preselected different amounts of material, each less than said target amount;
   actuator means for actuating said discharge means in response to a command signal;
   movable support means carrying said discharge means to and from said actuator means;
   drive means for moving said movable support means so as to carry preselected ones of said discharge means to said actuator means in response to a drive signal; and
   control means coupled to said actuator means for sending said command signal thereto and further coupled to said drive means for sending said drive signal thereto, said control means operable: to send a first drive signal to said drive means so as to carry one of said discharge means to said actuator means, to send a first command signal to discharge a first preselected amount of material, less than said target amount, therefrom, to thereafter send a second drive signal to said drive means so as to move said movable support means so as to carry the other of said discharge means to said actuator means and to send a second command signal to said actuator means to discharge a different preselected amount of material, less than said target amount, therefrom so that the amounts of material dispensed combine to achieve the target amount with an improved accuracy.
2. The apparatus of claim 1 comprising a plurality of material sources, each containing a material to be dispensed at a dispensing station where said actuator means is located; and multiple sets of discharge means coupled to respective material sources, each set containing a larger and a smaller discharge means.

3. The apparatus of claim 2 wherein said sets of discharge means are spaced apart on said movable support means with a preselected minimum spacing, and the discharge means of each set are spaced apart from one another with a smaller spacing.

4. The apparatus of claim 3 wherein said control means, for each dispensing operation, issues a first drive signal to move a preselected set of discharge means to said dispensing station with one of said larger and said smaller discharge means positioned at the dispensing station, and after issuing a command signal to said actuator means, issues a second drive signal to position the other of said larger and said smaller discharge means at the dispensing station to complete the dispensing operation.

5. The apparatus of claim 1 wherein said discharge means comprise metering pumps.

6. The apparatus of claim 5 wherein said metering pumps have multiple parts telescopically movable with respect to each other and said actuator means displaces at least one said part with a telescopic movement.
7. The apparatus of claim 1 wherein each discharge means is coupled to a respective material source.

8. The apparatus of claim 1 wherein said movable support means comprises a turntable, and said sets of discharge means are angularly displaced from one another by at least a first amount, with angular displacements measured from the center of the turntable.

9. The apparatus of claim 8 wherein said discharge means of each set are angularly displaced from one another, with smaller angular displacements also measured from the center of the turntable, which are smaller than the first amount.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(5) : B67D 5/52
US CL : 222/135, 144, 144.5, 168, 380; 141/104
According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 222/014, 135, 144, 144.5, 168, 380; 141/103, 104, 105; 566/605

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US, A, 5,119,973 (Miller et al.) 09 June 1992, see entire document.</td>
<td>1-9</td>
</tr>
<tr>
<td>X</td>
<td>US, A, 4,027,785 (Edstrom et al.) 07 June 1977, see entire document.</td>
<td>1-9</td>
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<tr>
<td>A</td>
<td>US, A, 4,913,202 (Miller et al.) 03 April 1990.</td>
<td>-</td>
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<tr>
<td>A</td>
<td>US, A, 4,258,759 (Achen) 31 March 1981.</td>
<td>-</td>
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</tbody>
</table>

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

"A" Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be part of particular relevance
"E" earlier document published on or after the international filing date
"L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search
16 MAY 1994

Date of mailing of the international search report
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