Dec. 22, 1964 H. W. KOGAN ETAL 3,162,335

ADJUSTABLE LIQUID DISPENSER

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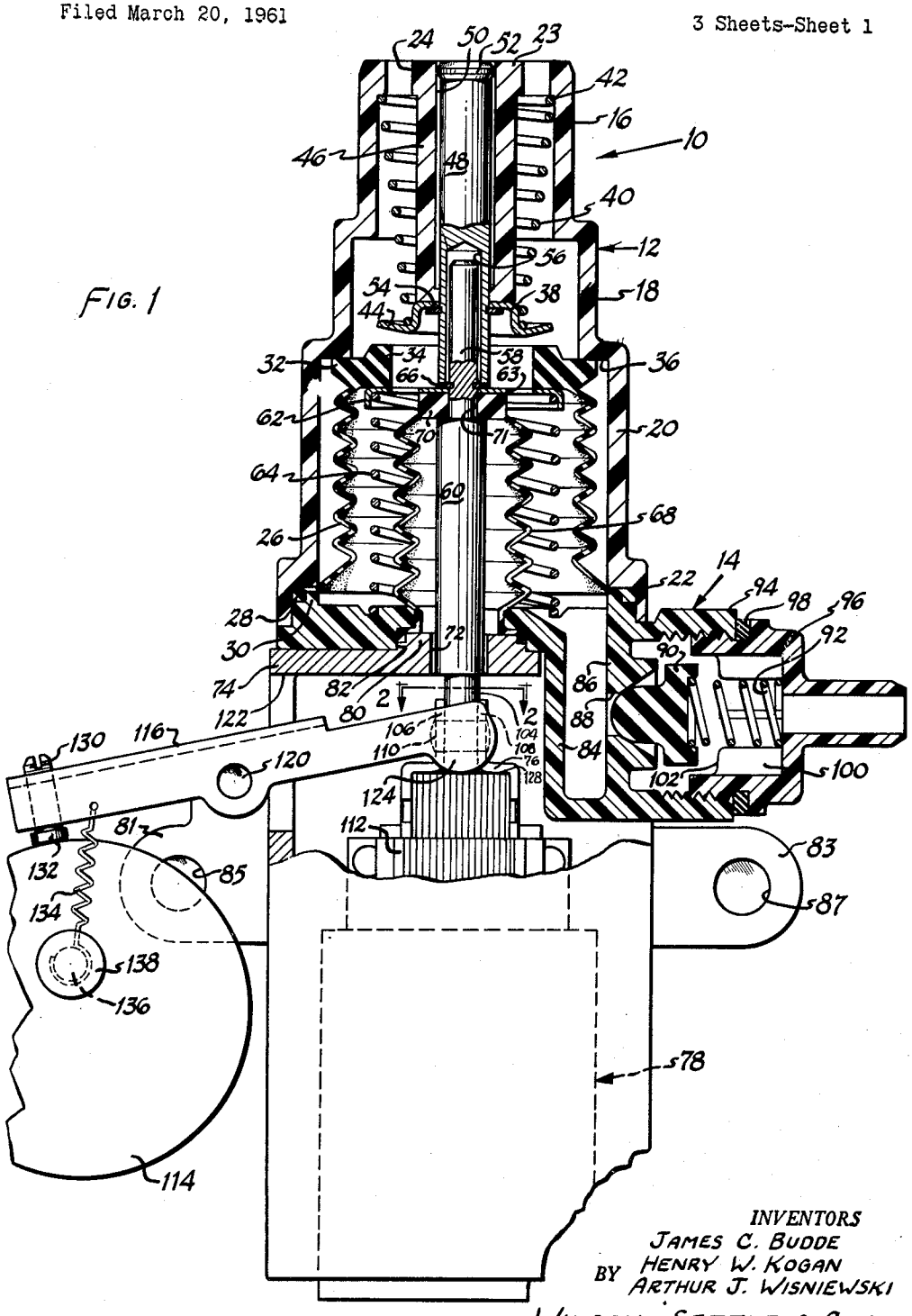
FIG. 1



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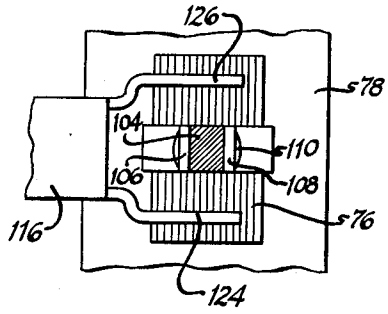

FIG. 2

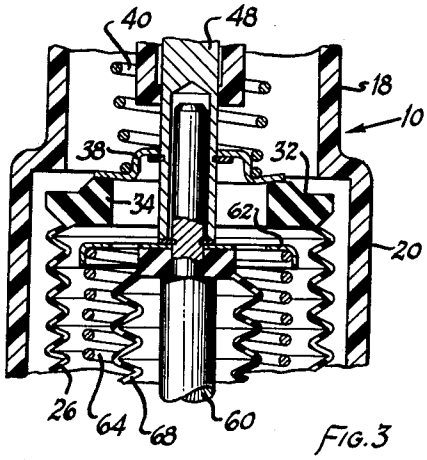

FIG. 3

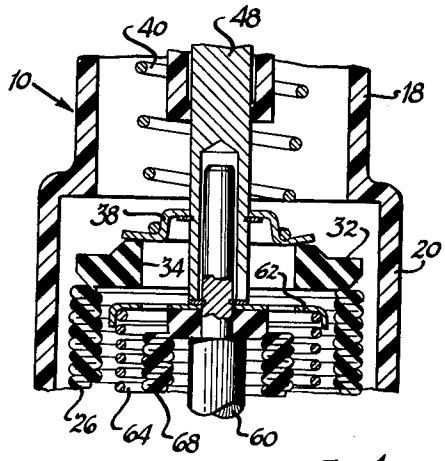

FIG. 4

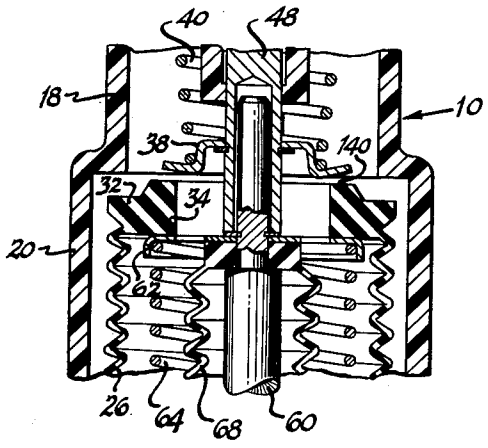

FIG. 5

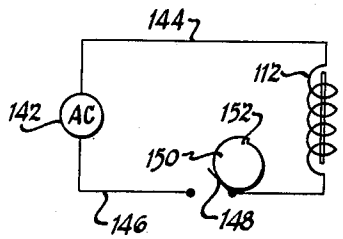

FIG. 6

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ADJUSTABLE LIQUID DISPENSER

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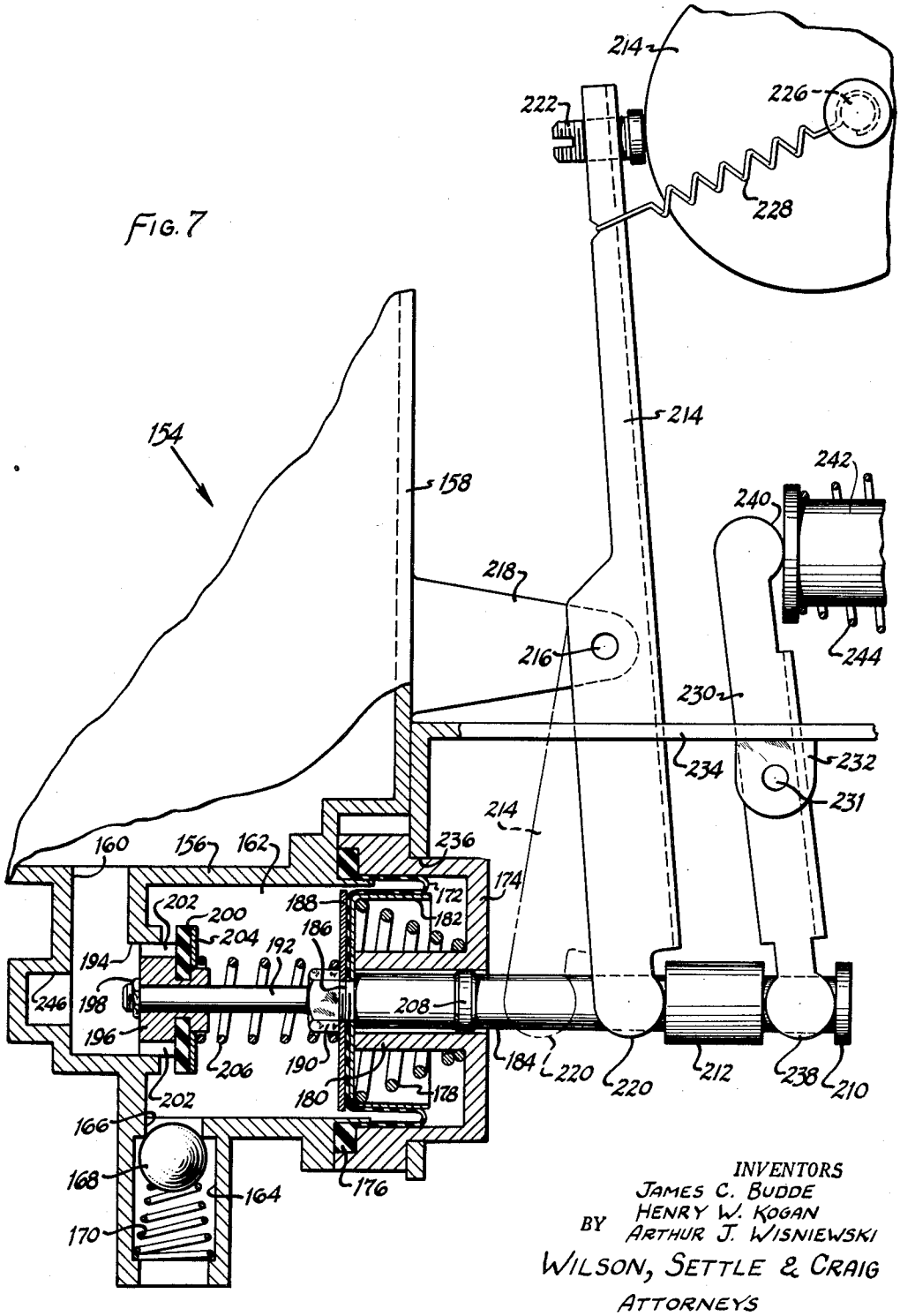
FIG. 7



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3,162,335

ADJUSTABLE LIQUID DISPENSER

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11 Claims. (Cl. 222—212)

The present invention relates to an adjustable liquid dispensing device. More particularly, this invention relates to a device for storing and metering an adjustable amount of a liquid additive into home appliances, such for example, as clothes or dishwashing machines and into vending machines, such for example, as coffee or soft drink machines.

There has been a strong demand in the home appliance and vending machine industries for liquid dispensing devices which are capable of accurately and quickly dispensing adjustable amounts of liquid additives. It is desirable that such dispensing devices be capable of automatically metering adjustable predetermined amounts of liquid additives and be capable of storing a sufficient quantity of additives for a large number of operations.

One factor in the appliance industry leading to the need for automatic liquid dispensing devices has been the trend in recent years towards the development and marketing of automatic clothes and dishwashing machines. This trend has included within its scope the automation of numerous tasks ancillary to the actual washing process. One such task which has recently drawn the attention of the appliance industry is that of dispensing the various liquid additives which are used in the washing process. In particular, there has been a need for a dispensing device for use with dishwashing machines. The dispensing device is needed for the injection of a rinse additive into the machine to produce spot-free drying of dishes. It is impractical for the housewife to add a rinse additive at the point in the dishwashing process where it is needed, i.e., during the rinsing process which follows the actual washing step. While the present invention is not limited to dishwashing machines, it is particularly adapted to be used with such appliances.

One desirable feature of such a liquid dispensing device is that it be operable with a minimum number of component parts. Simplicity of design results in reducing manufacturing costs. Manufacturing costs are, of course, vitally important when considering the addition of an ancillary device to an appliance. Preferably, the dispenser is not of the type that will break down under normal use and need expensive servicing. It should be rugged and durable in use. Another important feature is that the device have accurate adjustable metering means. A small metering error is very significant in proportion to the small total amount of additive dispensed in each operation.

Therefore, an object of the invention is to provide a liquid dispensing device which will automatically dispense adjustable metered amounts of liquid.

Another object is to provide an electrically-operated dispensing device which may be conveniently correlated with the cycle of the machine with which it is used.

A further object is to provide a structure having a storage container of sufficient capacity to dispense the required amount of liquid wetting agent, detergent, bleach, or other additive for a large number of operations.

Another object is to provide a dispenser which is operated by an electric solenoid but in which the solenoid does not directly act to force the liquid out of the dispenser during dispensing.

A still further object is to provide a dispensing device which is rapid acting to dispense the required amount of liquid in a very short period of time.

Another object is to provide a dispensing device of the universal type which can be constructed to handle many different kinds of liquid.

A yet further object is to provide a device which is self-priming to avoid the necessity for a mechanism to fill the metering chamber after each dispensing operation.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a front elevational view partly in section showing one embodiment of the present invention;

FIGURE 2 is a sectional view taken substantially along line 2—2 of FIGURE 1 looking in the direction of the arrows and showing the solenoid plunger and associated structure utilized to actuate the dispenser mechanism;

FIGURE 3 is a sectional view of a portion of the metering chamber of the FIGURE 1 embodiment showing the relationship of the various parts just prior to a dispensing operation;

FIGURE 4 is a sectional view similar to FIGURE 3 showing the relationship of the parts during a dispensing operation;

FIGURE 5 is a sectional view similar to FIGURE 3 showing the metering chamber during the refilling cycle after a dispensing operation;

FIGURE 6 is a schematic view of suitable control means for operating the dispenser of FIGURE 1; and

FIGURE 7 is a side elevational view of a second embodiment of the present invention partly in section for the purpose of clarity.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to FIGURES 1 and 2, the dispenser 10 comprises a body composed of an upper member 12 and a lower member 14. The upper member 12 is composed of successively larger sections 16, 18, 20, 22. A plurality of circumferential openings 24 are provided in the upper wall 23 of section 16 and serve as an inlet to the dispenser. The dispenser is adapted to be gravity fed from a liquid reservoir (not shown) positioned thereabove. The reservoir may be directly connected to section 16 or a tube may be connected to section 16 to communicate with a reservoir.

Positioned within body section 20 is a collapsible bellows 26. The lower peripheral edge portion 28 of the bellows extends into the recess formed by body section 22 and is clamped in this position by reduced portion 30 of the lower body member 14. The upper and lower body members may be conveniently secured together by screws (not shown). The edge 28 of the bellows forms a fluid-tight seal at the juncture of the upper and lower body members.

The upper end of the bellows is provided with a thick relatively rigid section 32 having an opening 34 therethrough forming a liquid inlet into the bellows. In the position shown in FIGURE 1, section 32 abuts against a shoulder 36 formed by the juncture of sections 18, 20. The shoulder 36 serves as a stop to limit expansion of the bellows.

A valve element **38** is provided to close the bellows opening **34** during dispensing of liquid. The valve element **38** is biased by spring **40** towards its closed position. The upper end of spring **40** abuts against a shoulder **42** and the lower end of the spring contacts peripheral flange **44** of the valve element. The spring **40** is inserted over tubular guide member **46** which extends downwardly from the wall **23**. Valve element **38** is provided with a guide stem **48** to properly position the valve element with respect to the bellows opening **34**. The valve stem **48** extends into opening **50** of the tubular guide **46** and has an enlarged portion **52** which engages the side walls of the opening **50** to guide the stem during stem movement. The stem **48** extends downwardly through an opening in valve element **38** and has washer **54** which abuts against the lower surface of the valve element to hold the valve element against downward movement on the stem.

The lower end of guide stem **48** is provided with an axially extending recess **56** to receive reduced portion **58** of a second stem **60**. The stem **60** carries a cup-shaped member **62** which is biased upwardly by spring **64** into abutment with washer **66** provided on the reduced portion **58**. The washer **66** in turn abuts against the lower end of the guide stem **48**. The spring **64** is stronger than the valve spring **40**, and thus serves to maintain the guide stem **48** and attached valve element **38** in the normal non-dispensing position shown. Member **62** is provided with openings **63** so that it will not block the passage of liquid through bellows opening **34**.

A second bellows element **68** is positioned within the main bellows **26**. The bellows **68** serves as a sealing element. The upper enlarged resilient portion **70** has an opening **71** through which is inserted reduced stem portion **58** to thus seal the interior of bellows **68** from the liquid in the dispenser. The lower end of the stem **60** extends through bellows **68** and thence through an opening **72** in a bracket **74** and is attached to a plunger **76** of an electric solenoid **78**. The bracket **74** has a boss **80** which extends into an opening **82** provided in the lower body member **14**. The lower peripheral edge portion of the bellows **68** is clamped between the bracket boss **80** and the body member **14** to thus seal the body opening **82**. The bracket has projections **81**, **83** with openings **85**, **87** for the reception of fastening means to secure the dispenser structure to a suitable support structure.

The space between the two bellows elements **26**, **68** along with the lower body member **14** forms the metering chamber of the dispenser. A liquid outlet structure is provided in body member **14** for the dispensing of liquid from the metering chamber. The body member **14** has a recess formed by opposed interconnected downwardly extending walls **84**, **86**. An opening **88** is provided in wall **86**. The opening **88** is normally closed by check valve element **90** which is biased to the closed position by spring **92**. An internally threaded tubular extension **94** extends outwardly from wall **86**. An externally threaded spout **96** threadingly engages the extension **94**. A gasket **98** is provided to seal these elements together in fluid-tight relationship. The spout **96** has a plurality of interior radial flanges **100** which surround and guide the check valve spring **92**. The inner ends **102** of flanges **100** act as a stop to limit outward movement of the valve element **90**. However, when the valve element **90** abuts against the flanges **100**, fluid can still flow from the metering chamber around the flanges **100** to be discharged from the spout.

Control of the time of dispensing and the amount of material dispensed is accomplished by means of the solenoid **78** and associated adjusting means. Downwardly projecting portion **104** of stem **60** extends between ears **106**, **108** of plunger **76** and is secured thereto by a pin **110**. As will be appreciated, energization of the solenoid coil **112** is effective to pull the plunger **76** downwardly. Downward movement of the plunger **76** will move the stem **60** downwardly, compressing the spring **64** and bellows **68**. This movement is effective to permit the spring **40** to move the valve element **38** to close the bellows openings **34**. Continued expansion of the spring **40** is effective to compress the bellows **26** and force the check valve element **90** to an open position whereupon fluid contained in the metering chamber is discharged from the dispenser spout **96**.

The spring **40** will continue to compress the bellows **26** until the lower end of stem **48** again engages the washer **66** carried on stem **60**. The length of the stroke of the plunger **76** determines the amount of compression of the bellows **26** and thus controls the amount of fluid dispensed from the dispenser.

Means are provided to adjust the length of the stroke of the plunger **76** to permit dispensing adjustable amounts of liquid. The adjusting means comprises a cam **114** which is operative to position adjusting arm **116** to set the plunger for the desired length of stroke. The arm **116** is pivotally mounted intermediate its ends on projection **81** of the bracket **74** by pin **120**. The arm **116** extends through an opening **122** in the bracket and has curved ears **124**, **126** on its inner end. The ears **124**, **126** extend around plunger ears **106**, **108** and abut against the plunger surface **128**. The outer end of the arm **116** threadingly receives screw **130** having a head **132** in pressure contact with the outer periphery of the cam **114**. The head **132** is maintained in pressure contact with the cam by means of spring **134** which extends from the arm into engagement with the cam shaft **136**. The spring is prevented from sidewise movement on shaft **136** by a washer **138**.

The cam **114** comprises a circular element mounted for rotation on the shaft **136**. The shaft **136** is positioned eccentrically of the center of the circle whereby rotation of the cam is effective to move the screw head **132** closer or farther away from the shaft **136**.

As will be appreciated, such movement of the head **132** will cause the arm **116** to pivot about pin **120**. Pivoting of the arm **116** in the clockwise direction, as viewed in FIGURE 1, will cause the ears **124**, **126** to move the solenoid plunger **76** downwardly to thus shorten the stroke of the plunger. Counterclockwise rotation of the arm **116** will result in upward movement of the ears **124**, **126**, and the spring **64** will move the plunger **76** upwardly to thus lengthen the plunger stroke. In the position shown in the FIGURE 1, the cam **114** is positioned to allow the plunger **76** to have its maximum stroke.

FIGURES 3, 4 and 5 illustrate one dispensing cycle. The figures depict a situation in which the stroke of the solenoid plunger is less than maximum to more clearly illustrate the mode of operation of the dispenser.

FIGURE 3 illustrates the dispenser in its initial position before a dispensing cycle. As will be noted, the stem **60** is positioned at a point lower than that shown in FIGURE 1. The valve element **38** of course follows the stem downwardly and thus is also positioned at a location lower than that shown in FIGURE 1. The bellows **26**, being biased in its manufacture to expand, does not have its upper section **32** in abutment with the cup member **62** as in FIGURE 1, but instead abuts against the valve element **38**. In this position, the opening **34** is closed and dispensing will start immediately upon downward movement of the guide stem **48**.

Upon energization of the solenoid, the stem **60** is retracted, permitting the valve element **38** to collapse the bellows **26** as shown in FIGURE 4. As previously explained, such collapsing is effective to discharge liquid through the spout **96**. Upon de-energization of the solenoid, the spring **64** will force the guide stem **48** and valve element **38** upwardly. The bellows **26** does not expand to its uncollapsed position as rapidly as the movement of the spring **64** carries the cup **62** upwardly. Consequently, during upward movement of the cup **62**, the upper surface of the cup will engage the bellows section **32** to move the bellows to its uncollapsed position.

During this upward movement, as will be noted in FIGURE 5, there is a gap 140 between the valve element 38 and the bellows section 32. This gap 140 permits the bellows to be refilled during upward travel. Material is drawn into the bellows as a result of the vacuum created by bellows expansion. After the other components have come to rest by virtue of abutment of the solenoid plunger against the inner end of adjusting arm 116, the bellows will slowly expand to again reach the position shown in FIGURE 3.

Actuation of the dispenser 10 may be conveniently correlated with the timing mechanism conventionally employed in automatic appliances. A typical arrangement is shown in FIGURE 6. As there shown, a source of power 142 has leads 144, 146 applied to the coil 112 of the solenoid. A normally open switch 148 is provided in lead 146. A cam 150, which may be mounted on the cam shaft of the timing mechanism, is provided to close the switch at the desired time in the washing cycle. When the cam has rotated to a position where lobe 152 contacts switch 148, the switch will be closed. As soon as the cam lobe 152 rotates beyond the switch 148, the switch will open. Dispensing is, of course, accomplished during the period when the switch is closed.

FIGURE 7 illustrates a second embodiment of the invention. The dispenser 154 comprises body member 156 which is formed integrally with a reservoir structure 158. An inlet passageway 160 leads downwardly from the reservoir 158 and opens into metering chamber 162 for gravity feed into the metering chamber. An outlet passageway 164 leads downwardly from the metering chamber. Port 166 in the outlet passageway is normally closed by ball valve element 168 which is biased to the closed position by a spring 170.

Flexible diaphragm 172 forms one wall of the metering chamber 162. The diaphragm 172 is held in place by body member cap 174. The peripheral edge portions 176 of the diaphragm act to seal the juncture of body members 156, 174.

The diaphragm 172 is biased by a spring 178 to deform and expel fluid contained in the metering chamber through the outlet 166. The spring 178 is inserted over inwardly extending tubular portion 180 of the cap 174. A cup-shaped member 182 is provided to contain spring 178 and abut against the diaphragm. The cup member 182 is carried on a stem 184. The stem 184 extends through tubular portion 180 and has a reduced threaded section 186 which extends through openings in the cup member and diaphragm. A stiffening plate 188 is inserted over the threaded section 186 and abuts against the inner surface of the diaphragm 172. This assembly is held in place by a nut 190 which threadingly engages threaded portion 186.

A second reduced stem section 192 extends inwardly from the threaded portion 186 towards inlet port 194. The stem section 192 slidingly extends through valve element 196 and terminates a short distance therebeyond. A nut 198 is provided on the end of the stem section 192 to retain the valve element 196. Valve element 196 carries a resilient disc 200 for closure of the port 194. The disc 200 abuts against radial guide flanges 202 provided on the periphery of valve element 196. The flanges 202 act as guide members for the valve element through port 194. Liquid can flow, however, from the reservoir around the flanges 202 to fill the metering chamber. A stiffening plate 204 is provided on the back of disc 200. A spring 206 abuts against plate 204 at one end and against plate 188 at the other end, thus biasing the valve element towards the closed position. The spring 206 is weaker than the spring 178, and is overcome by the spring 178 during a dispensing operation to permit deformation of the diaphragm 172.

The stem 184 projects rearwardly through the tubular portion 180 and terminates exteriorly of the dispenser body. The stem is guided in a sliding path through tubular portion 180 by an enlarged annular section 208. The stem is provided with enlarged annular portion 210 at its outer terminus and with a second enlarged annular portion 212 adjacent thereto.

As in the FIGURE 1 embodiment, an arm 214 is provided to limit the length of the stroke of the stem 184. Arm 214 is pivotally mounted by means of pin 216 to a bracket 218 which extends outwardly from reservoir structure 158. The arm 214 is a channel section and has ears 220 which project over the stem 184 at a point between annular portion 212 and the dispenser body cap 174. The upper end of the arm 14 is provided with a threadable screw 222, the head of which engages cam wheel 214 which is eccentrically mounted on axis 226 as in the FIGURE 1 embodiment. A spring 228 maintains the screw and cam in engagement as previously described. The ears 220 of the arm 214 act as stop members to limit inward movement of the stem 184. In the position shown in full lines, the arm 214 prevents any inward movement of the stem. This is the zero dispensing position. When positioned as shown in dotted lines, the arm 214 will permit inward movement of the stem 184 a distance equal to the distance between ears 220 and the enlarged portion 212.

A second arm 230 is provided to actuate the diaphragm 172. The arm 230 is pivotally mounted by means of pin 231 on projection 232 which extends downwardly from a bracket 234. The bracket 234 has an opening 236 and is inserted over the dispenser cap 174. Bracket 234 is secured to the dispenser body as by welding. The arm 230 has ears 238 as its lower end which project over the stem 184 between annular enlargements 210, 212. The upper end of arm 230 is curved at 240 and normally abuts against the outer end of solenoid plunger 242. The solenoid plunger 242 is biased outwardly to the position shown by a spring 244. Energization of the solenoid coil (not shown) is effective to withdraw the plunger 242 and permits the arm 230 to pivot in a clockwise direction as viewed in FIGURE 7.

In operation of the dispenser, the solenoid 242 is withdrawn, and the spring 178 deforms the diaphragm 172 to reduce the volume of the metering chamber. The action of the spring 178 also carries the stem 184 inwardly to move the disc 200 to close the port 194.

Continued deformation of the diaphragm after closure of port 194 operates to force liquid contained in the metering chamber out through the port 166. The stem section 192 slides through the valve element 196 and is received in a recess 246 in the inlet passageway during the dispensing operation. When the annular portion 212 on the stem abuts against the ears 220 of arm 214, the dispensing operation ends. As will be appreciated, the amount of deformation of the diaphragm is determined by the length of the stroke of stem 184. Consequently, the amount of liquid dispensed is determined by the length of the stem stroke. The length of the stem stroke is made adjustable by positioning the arm 214 as previously described.

After liquid has been dispensed, the solenoid plunger 242 is again extended, pivoting the arm 230 in a counterclockwise direction to withdraw the diaphragm 172 and eventually open the port 194. The vacuum created in the metering chamber during withdrawal of the diaphragm is effective to draw more fluid from the reservoir into the metering chamber to refill the chamber for the next dispensing operation. Control of the operation of the dispenser may be integrated into the appliance timing system as shown in FIGURE 6.

An important feature of both the FIGURE 1 and FIGURE 7 embodiments is that the motivating force to deform the flexible wall during dispensing is provided by a spring and not by the solenoid. This arrangement permits the solenoid plunger to retract quickly. Deformation of the flexible wall during dispensing is a relatively slow process. If the wall were deformed by the sole-

noid plunger, the slow plunger movement would cause solenoid "chatter" or noise and would also cause excessive wear of the solenoid. Slow return of the solenoid plunger does not cause a problem because the return is effected by a spring.

Having thus described our invention, we claim:

1. In a liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; valve means for said inlet operative to open the inlet for filling the metering chamber and to close the inlet during dispensing; valve means for said outlet operative to close the outlet during filling of the chamber and to open the outlet during dispensing; and flexible wall means forming a portion of the wall of said metering chamber; said flexible wall means being deformable to expel liquid from the metering chamber through said outlet; the improvement comprising the provision of resilient means biasing the flexible wall means to a deformed position; a slidable stem member normally positioned to oppose said resilient means and prevent deformation of the flexible wall means; means to move the stem out of its normal opposing position and through a stroke of predetermined length whereby the resilient means is effective to deform the flexible wall means to dispense a quantity of liquid through said outlet; the amount of liquid dispensed being determined by the amount of deformation of the flexible wall means; the amount of deformation of the flexible wall means being determined by the length of the stem stroke; and means to adjust the length of the stem stroke comprising a stop member on the stem; an arm pivotally mounted intermediate its ends; a first end of said arm being positionable along the longitudinal axis of the stem; means associated with a second end of the arm to pivot the arm and move the first end to a selected position with respect to the stem stop member; contact of said first end with the stop member on the stem being effective to determine the length of the stem stroke.

2. In a liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; valve means for said inlet operative to open the inlet for filling the metering chamber and to close the inlet during dispensing; valve means for said outlet operative to close the outlet during filling of the chamber and to open the outlet during dispensing; and flexible wall means forming a portion of the wall of said metering chamber; said flexible wall means being movable toward the outlet to expel liquid from the metering chamber through said outlet; the improvement comprising the provision of resilient means biasing the flexible wall means toward said outlet; a slidable stem member normally positioned to abut against said resilient means and prevent movement of the flexible wall means; an electric solenoid having a slidable plunger operatively connected to the stem to maintain the stem in its normal position; activation of the solenoid being effective to cause the stem to move out of its normal abutting position and through a stroke of predetermined length whereby the resilient means is effective to move the flexible wall means to dispense a quantity of liquid through said outlet; the amount of liquid dispensed being determined by the amount of movement of the flexible wall means; the amount of movement of the flexible wall means being determined by the length of the stem stroke; and means to adjust the length of the stem stroke.

3. In a liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; valve means for said inlet operative to open the inlet for filling the metering chamber and to close the inlet during dispensing; valve means for said outlet operative to close the outlet during filling of the chamber and to open the outlet during dispensing; and flexible wall means forming a portion of the wall of said metering chamber; said flexible wall means being deformable to expel liquid from the metering chamber through said outlet; the improvement comprising the provision of resilient means biasing the flexible wall means to a deformed position; a slidable stem member normally positioned to oppose said resilient means and prevent deformation of the flexible wall means; means to move the stem out of its normal opposing position and through a stroke of predetermined length whereby the resilient means is effective to deform the flexible wall means to dispense a quantity of liquid through said outlet; the amount of liquid dispensed being determined by the amount of deformation of the flexible wall means; the amount of deformation of the flexible wall means being determined by the length of the stem stroke; and means to adjust the length of the stem stroke comprising a stop member on the stem; an arm pivotally mounted intermediate its ends; a first end of said arm being positionable along the longitudinal axis of the stem; a rotatable cam in contact with the second end of the arm to pivot the arm and move the first end to a selected position with respect to the stem stop member; contact of said first end with the stop member on the stem being effective to determine the length of the stem stroke.

4. In a liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; valve means for said inlet operative to open the inlet for filling the metering chamber and to close the inlet during dispensing; valve means for said outlet operative to close the outlet during filling of the chamber and to open the outlet during dispensing; and flexible wall means forming a portion of the wall of said metering chamber; said flexible wall means being movable toward the outlet to expel liquid from the metering chamber through said outlet; the improvement comprising the provision of resilient means biasing the flexible wall means toward said outlet; an electric solenoid having a slidable plunger normally positioned to abut against said resilient means and prevent movement of the flexible wall means; activation of the solenoid being effective to move the plunger out of its normal abutting position and through a stroke of predetermined length whereby the resilient means is effective to move the flexible wall means to dispense a quantity of liquid through said outlet; the amount of liquid dispensed being determined by the amount of movement of the flexible wall means; the amount of movement of the flexible wall means being determined by the length of the plunger stroke; and means to adjust the length of the plunger stroke.

5. A liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; check valve means releasably closing said outlet; a valve element for said inlet; flexible wall means forming a portion of the wall of said metering chamber; said flexible wall means being movable toward the outlet to dispense liquid from the metering chamber through said outlet; resilient means biasing said valve element to close and said flexible wall means to move toward said outlet; an electric solenoid having a slidable plunger normally positioned to abut against said resilient means and prevent movement of the flexible wall means; activation of the solenoid being effective to move the plunger out of its normal abutting position and through a stroke of predetermined length whereby the resilient means is effective to bias said valve element to close the inlet and to move the flexible wall means to dispense a quantity of liquid determined by the amount of movement of the flexible wall means; the amount of movement of the flexible wall means being determined by the length of the plunger stroke; and means to adjust the length of the plunger stroke.

6. A liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; check valve means releasably closing said outlet; a valve element for said inlet; a collapsible bellows forming a portion of the wall of said

metering chamber; said bellows being collapsible to dispense liquid from the metering chamber through said outlet; resilient means biasing said valve element to close and said bellows to collapse; an electric solenoid having a slidable plunger normally positioned to oppose said resilient means and prevent collapse of the bellows; activation of the solenoid being effective to move the plunger out of its normal opposing position and through a stroke of predetermined length whereby the resilient means is effective to bias said valve element to close the metering chamber inlet and collapse the flexible wall means to dispense a quantity of liquid determined by the amount of deformation of the bellows; the amount of deformation of the bellows being determined by the length of the plunger stroke; and means to adjust the length of the plunger stroke.

7. A liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; check valve means releasably closing said outlet; a valve element for said inlet; a flexible bellows forming a portion of the wall of said metering chamber; said bellows being deformable to dispense liquid from the metering chamber through said outlet; resilient means biasing said valve element to close and said bellows to deform; an electric solenoid having a slidable plunger normally positioned to oppose said resilient means and prevent deformation of a bellows; activation of the solenoid being effective to move the plunger out of its normal opposing position and through a stroke of predetermined length whereby the resilient means is effective to bias said valve element to close the metering chamber inlet and to deform the bellows to dispense a quantity of liquid determined by the amount of deformation of the bellows; the amount of deformation of the bellows being determined by the length of the plunger stroke; and means to pre-position the plunger prior to activation of the solenoid to thus vary the length of the plunger stroke upon activation of the solenoid.

8. A liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; check valve means releasably closing said outlet; a valve element for said inlet; flexible bellows forming a portion of the wall of said metering chamber; said bellows being deformable to dispense liquid from the metering chamber through said outlet; resilient means biasing said valve element to close and said bellows to deform; an electric solenoid having a slidable plunger normally positioned to oppose said resilient means and prevent deformation of the bellows; activation of the solenoid being effective to move the plunger out of its normal opposing position and through a stroke of predetermined length whereby the resilient means is effective to bias said valve element to close the inlet and deform the bellows to dispense a quantity of liquid determined by the amount of deformation of the bellows; the amount of deformation of the bellows being determined by the length of the plunger stroke; and means to adjust the length of the plunger stroke comprising a stop member on the plunger; an arm pivotally mounted intermediate its ends; a first end of said arm being positionable along the longitudinal axis of the plunger; means associated with the second end of the arm to pivot the arm and move the first end to a selected position with respect to the plunger stop member; contact of said first end with the stop member on the plunger being effective to determine the length of the plunger stroke.

9. A liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; check valve means releasably closing said outlet; an inlet valve element; flexible bellows forming a portion of the wall of said metering chamber; said bellows being deformable to dispense liquid from the metering chamber through said outlet; resilient means biasing and inlet valve element to close the metering chamber inlet and deform said bellows; an electric solenoid having a slidable plunger normally positioned by second resilient means to oppose said first resilient means; said second resilient means being stronger than said first resilient means to thereby prevent deformation of the bellows; activation of the solenoid being effective to move the plunger against the second resilient means out of its normal opposing position and through a stroke of predetermined length whereby the first resilient means is effective to bias said inlet valve element to close the inlet and to deform the bellows to dispense a quantity of liquid determined by the amount of deformation of the bellows; the amount of deformation of the bellows being determined by the length of the plunger stroke; and means to move the plunger against the action of said second resilient means to pre-position the plunger prior to activation of the solenoid to thereby adjust the length of the plunger stroke.

10. A liquid dispenser comprising a body having a liquid metering chamber; an inlet to said metering chamber; an outlet from said metering chamber; check valve means releasably closing said outlet; an inlet valve element; a flexible diaphragm forming a portion of the wall of said metering chamber; a stem member operatively connected to said diaphragm; a portion of the stem extending into the metering chamber and slidably carrying said inlet valve element; first resilient means between the diaphragm and inlet valve element biasing said inlet valve element towards closure of the metering chamber inlet; second resilient means, stronger than said first resilient means, biasing said diaphragm to a deformed position to dispense liquid from the metering chamber through said outlet; an electric solenoid having a slidable plunger operatively connected to said stem and normally positioned to oppose said second resilient means and prevent deformation of the diaphragm; activation of said solenoid being effective to move the solenoid plunger out of its normal opposing position and permit said second resilient means to deform the diaphragm and move the stem through a stroke of predetermined length thereby closing the metering chamber inlet and dispensing a quantity of liquid determined by the amount of deformation of the diaphragm; the amount of deformation of the diaphragm being determined by the length of the stem stroke; and means to adjust the length of the stem stroke.

11. A dispenser as claimed in claim 10 and further characterized in that the means to adjust the length of the stem stroke comprise a stop member on the stem; an arm pivotally mounted intermediate its ends; a first end of said arm being positionable along the longitudinal axis of the stem; means associated with the second end of the arm to pivot the arm and move the first end to a selected position with respect to the stem stop member; contact of said first end with the stop member being effective to determine the length of the stem stroke.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,162,335 December 22, 1964

Henry W. Kogan et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 10, line 5, for "and" read -- said --.

Signed and sealed this 22nd day of June 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents