

BEVERAGE BREWING APPARATUS

5 This invention relates to a beverage brewing apparatus suitable for use in a beverage vending machine.

10 Coffee and other beverage brewing apparatus suitable for use in a vending machine for preparing single cup quantities of beverages from beverage material is well known in the prior art. For example, US-A-3349690 discloses one construction for such a brewing apparatus.

15 Referring to Figure 1 of the accompanying drawings, the basic construction and brewing cycle of a prior art coffee brewing apparatus will be described.

20 A frame 1 of the apparatus supports a vertically movable open-bottomed cylinder 2 which has its bottom opening covered by a filter member 3. A vertically movable piston 4 is disposed within the cylinder 2 and relative movement between the cylinder 2 and piston 4 is created by operation of a cam member 5 driven by a motor 6. One end opening of a duct 7 is connected with a water tank (not shown) through an electromagnetic valve 9, this end opening being closely placed above a top opening of the cylinder 2 to supply hot water into the cylinder 2. A brewing cavity 10 which is generally reciprocatable horizontally between a brewing position (shown by a full line in Figure 1) and a rest position (shown by dot and dash line in Figure 1) is located beneath the cylinder 2 and sealed with the lower portion of the cylinder 2 in the brewing position.

35 The prior art apparatus is also provided with a coffee hopper 11 with is connected with a canister 12 for receiving a charge of coffee. The ground coffee

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fills the canister 12, which is provided with suitable feed means to deliver a predetermined quantity of fresh ground coffee into the hopper 11 at a point prior to the start of the brewing operation.

5 In this apparatus, the brewing cavity 10, at the start of a brewing cycle initiated by a coin operated switch for example, moves horizontally towards the brewing position from the rest position to beneath the bottom opening of the cylinder 2. During this
10 horizontal movement, the ground coffee is supplied into the brewing cavity 10 through the coffee hopper 11 at a supply position (indicated by the dotted line in Figure 1). When the brewing cavity 10 is properly aligned beneath the cylinder 2, as a result of the
15 operation of the cam member 5, the cylinder 2 moves downwardly into tight engagement with the cavity 10. This forms a chamber which is then filled with hot water supplied through the duct 7. Thereafter, the piston 4 moves downwardly to force the water through
20 the filter member 3 into the ground coffee in the cavity 10 and through an outlet conduit 13 to a cup 14 placed at a dispensing station. Before supply into the cup, extracted coffee would be mixed with suitable amount of sugar and/or cream which are
25 supplied from canisters 15, 16. Thereafter, the brewing cavity 10 containing the spent coffee grounds is moved to its rest position and the grounds in the brewing cavity 10 are ejected at or just before the rest position is reached. When the brewing cavity 10
30 has returned to its rest position, one brewing cycle has been completed.

During the brewing cycle, particularly during the extracting operation, the sealing between the inner surface of the cylinder 2 and the outer
35 peripheral surface of the piston 4 should be secure to effect an efficient extraction operation. Since the piston 4 is slidably disposed and sealed

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within the cylinder, the piston 4 should be moved straight downwards. However, movement of the piston 4 is controlled by the operation of the cam member 5, so that a horizontal force component is received by the piston 4 upon operation of the cam member 5. We have now appreciated that, as a result, there is a tendency for the axis of the piston 4 to become offset from the centre of the cylinder 2, and consequently, sealing between the piston 4 and cylinder 2 to fail.

According to the invention, a beverage brewing apparatus comprising a frame; a vertically movable cylinder member supported by the frame and having an open top and an open bottom; a piston member disposed in the cylinder and supported for vertical movement on the frame via supports; means for facilitating entry of hot liquid into the cylinder below the piston; a base assembly including a brewing cavity which is reciprocatable horizontally beneath the cylinder member between a brewing position and a discharge position and being sealed to the cylinder member in the brewing position; a camshaft driven by a motor; a plurality of cams on the camshaft; a first cam follower coupled to the piston; a second cam follower coupled to the cylinder, each cam follower being in contact with a respective one of the cams so that the piston and cylinder members are moved by operation of the cams through the cam followers; and a mechanism separate from the piston member, but connected therewith, for ensuring that, when the piston member is moved downwards, a horizontal component of the force received by the first cam follower and tending to produce a horizontal movement of the piston member and a displacement of the axis of the piston member from that of the cylinder member is resisted.

The invention will now be described by the way of example with reference to the accompanying

drawings, in which:-

Figure 1 is a diagrammatic view of a prior art brewing apparatus to illustrate the basic construction and brewing cycle;

5 Figure 2 is a diagrammatic front view of one example of a beverage brewing apparatus according to the invention;

Figure 3 is a diagrammatic side view of the first example;

10 Figure 4 is a diagrammatic plan view of the first example;

Figure 5 is a diagrammatic exploded perspective view of a cylinder and piston used in the first example;

15 Figure 6 is a diagrammatic view illustrating the operation of cam elements;

Figure 7 is a diagrammatic view of the apparatus illustrating the operation of dumping beverage grounds; and,

20 Figure 8 is a diagrammatic view of cam elements of a second example.

Referring to Figure 2 to 4, a beverage brewing apparatus 100 in accordance with the present invention includes a frame body 20 defined by a front wall 201, a rear wall 202 and side walls 203, 204. The rear wall 202 provides a base portion 21 including a filter supporting carriage 211 and brewing cavity carriage 212 to be described hereinafter. The side walls 203, 204 are used to maintain proper orientation between the front and back walls 201, 202.

30 A front guide rod 22 is supported by the front wall 201, and a rear guide rod 23 is also supported by the rear wall 202. The guide rods 22, 23 are generally diagonally opposite one another and support
35 a brewing cylinder 24 and a piston 25 to be described hereinafter.

5 The brewing cylinder 24 has a pair of supporting portions 241 projecting from an outer peripheral surface thereof. Each of the rods 22, 23 extends vertically through a respective one of the supporting portion 241 and is supported by a bearing support 202a on the rear wall 202 or a corresponding bearing support 201a on the front wall 201. A snap ring 26 is fitted on each of the guide rods 22, 23 above the supporting portion 241 and a spring 27 surrounds each of the rods 23, 24 above the snap ring 26. Thus, the cylinder 24 is fixed to, and movable with, the rods 22, 23. As clearly shown in Figure 2, the cylinder 24 has a top opening and a lower bottom opening 243, and the brewing cylinder 24 also has a sloped bottom 242 which extends to a reduced diameter lower opening 243 coaxial therewith. The lower opening 243 is covered by a fine mesh screen 28 which is removably disposed therein. This screen 28 prevents coffee grounds or other extract material from entering the cylinder 24 together with the hot water during a brewing operation.

25 The cylinder 24 is provided with a series of inlets 244 at its upper peripheral portion, and a chute 29 extends from an outer peripheral surface of the cylinder 24 around the inlet ports 244. The chute 29 has a sloping bottom wall 291 which communicates with the inlet ports 244 so that hot water may be introduced therein to below the piston 25 when the piston 25 is in its uppermost position.

30 The piston 25 remains at all times within the cylinder 24, and comprises upper and lower portions 251, 252, which are connected with one another by a bolt-nut arrangement 30, as shown in Figure 5. A seal element 31 on an outer peripheral surface of the upper portion 251 effects sealing between the cylinder 24 and the piston 25. The upper portion 252 of the piston 25 has its upper end integrally

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connected to a U-shaped bridge 253. Each end 253a, 253b of the bridge 253 is formed with a hole 32 through which one of the rods 22, 23 extends. The upper end of the spring 27, which surrounds each rod 22, 23 contacts with the end 253a or 253b of the bridge 253. The springs 27 thereby apply a force between the snap rings 26 and the ends 253a, 253b of the bridge 253, biasing the piston 25 upwardly.

A cam follower 33 and centering rotor 34 are rotatably supported by the bridge 253 through a shaft 35 disposed through a centre portion of the bridge 253. The ends 253a, 253b of the bridge 253 constitute a pair of bearing guides working as a three point suspension in conjunction with the sealing element 31 on the piston 25.

A guide element 39 is mounted at an inner surface of the front wall 201 to face the centering rotor 34, and the rotor 34 rolls along the guide element. Therefore, straight downward movement of the piston member 25 is ensured by the rolling motion of the centering rotor 34 along one side surface of guide element 39.

A cylinder operating bridge 36 has its ends secured to the upper ends of the rods 22, 23. The arrangement of the cylinder 24 being fixed on the lower ends of the rods 22, 23 and the cylinder operating bridge 36 being fixed on the upper ends of the rods 22, 23 provides a positive, rectangularly fixed central system for ensuring parallelism of the rods 22, 23 and for ensuring a smooth vertical arm 361 extending downwardly. The arm 361 of the bridge 36 is provided with a slot within which is rotatably supported a cam follower 37 via a support shaft 362 which cooperates with a cam 38.

A cam shaft 39' extends between the front and rear walls 201, 202. The rear wall 202 has a hole (not shown) through which one end of the cam shaft

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39' extends. This end of the cam shaft 39' is connected with a motor device 40. Three cams, a first cam 41 acting as a piston cam and cooperating with a piston cam follower 33, a second cam 37 cooperating with a bridge cam follower 37, and a third cam 42, are secured on the cam shaft 39'.

The base portion 21 includes upper and lower rods 43, 44. A brewing cavity carriage 212, which supports a brewing cavity 213, is slidably supported on the rods 43, 44. A filter support carriage 211, in which a filter is removably disposed, is also slidably supported on the rods 43, 44. The brewing cavity 213 has a groove at its upper surface to receive a seal element 47 to provide a seal with the lowermost surface of the cylinder 24.

A funnel support 45 is disposed between the front and rear walls 201, 202. A funnel 46 extends through, and is supported by the funnel support 45. The top of the funnel 46 has an outwardly extending rectangular flange. The bottom of the funnel 46 changes to a tubular section and forms an elbow, whereby liquid flowing therethrough may be finally directed to a cup for receiving the extracted beverage.

In this apparatus, upon initiation of an electrical input, which may be responsive to introducing a coin into a dispensing mechanism, the motor 40 turns the camshaft 39 clockwise as seen in Figure 2.

Upon rotation of the camshaft 39, the brewing cavity carriage 212 is moved horizontally towards the left in Figure 2 via the third cam 42. When the brewing cavity carriage 212 is above the filter support carriage 214, a predetermined amount of ground coffee is supplied into the brewing cavity 212 through the coffee hopper 51. After the brewing cavity 212 receives the ground coffee, the brewing

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cavity 212 continues to move towards the left, together with the filter support carriage 214. When the brewing cavity 212 is properly aligned beneath the cylinder 24, movement of the cavity and support carriages 213, 214 is stopped and the cylinder 24 is moved downwardly into tight engagement with the cavity 212. The tight sealing between the cylinder 24 and the brewing cavity 212 is provided by the seal element 47. As the cam shaft 39' continues to rotate, a predetermined amount of hot water is supplied into the cylinder 24 through the chute 29. The timing for the supply of the ground coffee into the brewing cavity 212 and of the hot water into the cylinder 24 is controlled by the rotation of a pulley 50 fixed on the front end of the cam shaft 39' extending from the front wall 201. The cam shaft 39' continues rotating clockwise and the piston follower 33 rides in a dwell section on the piston cam 41 as shown in Figure 6.

As the piston cam 41 rotates, the piston 25 is moved downwardly and, during the downward movement of the piston 25, the U-shaped bridge 253 compresses the springs 27 disposed around the guide rods 22, 23 to ensure a sealing on the seal element 47 disposed on the brewing cavity 212 and a seal element (not shown) between the lowermost opening of the brewing cavity 212 and the filter 211. During the brewing operation, the springs 27 are continuously compressed by downward movement of the U-shaped bridge 253 to secure the sealing between the cylinder 24 and the brewing cavity 212, and the brewing cavity 212 and the filter 211. After the piston 25 has passed the inlet ports 244 of the cylinder 24, a layer of sealed air is trapped between the top of the hot water surface and the bottom face of the piston 25. During the downward movement of the piston 25, the centering rotor 34 rolls along the side surface of the guide element 39. Therefore, horizontal movement of the

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piston 24, which may be caused by action of the piston cam 41, is prevented by contact between the centering rotor 34 and the guide element 39.

5 When the piston 25 reaches its position wherein all the hot water has been forced through the ground coffee in the brewing cavity 212, the piston 25 continues downwardly at a slightly increased speed for forcing hot air through the spent coffee grounds, and just prior to the end of the downward stroke, 10 approaches zero downward acceleration. That hot air passed through the spent coffee grounds dries out the grounds, rendering them in a dry state so that they may be easily discharged. The extracted beverage is supplied to a cup (not shown) through the funnel 46.

15 When the piston 25 reaches the end of its downward stroke, the cylinder 24 and piston 25 are moved slightly upwardly to clear the top flange on the brewing cavity 212. Therefore, the brewing cavity 212 is easily released from the brewing 20 position and moved toward the right in Figure 2.

When the filter support carriage 214 reaches a predetermined position, movement of the filter support carriage 214 is stopped, but the brewing cavity carriage 213 continues its rightward 25 movement. After the brewing cavity carriage 213 has separated from the filter support carriage 214, a pin 212a projecting from the brewing cavity 212 makes contact with a spring like pawl 215 formed on the base portion 21. This contact between the pin 212a 30 and the pawl 215 causes the cavity 212 to elevate owing to the horizontal movement of the brewing cavity 212. That is the brewing cavity moves upwardly from position X to Y owing its horizontal movement, and when the brewing cavity 212 reaches its 35 extreme top position Y, the pin 212a rides off the end of the pawl 215 and drops to position Z. This downward motion and abrupt stop of the brewing cavity

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212 at position Z causes the dried out spent coffee grounds to be ejected completely and freely from the cavity 212. This terminates one brewing cycle.

5 Figure 8 shows another example in which, during the downward movement of the piston 25', an outer peripheral surface of the bridge cam 38' usually contacts a surface of the U-shaped bridge 253' of the piston 25' to provide a reaction B which is opposed to the horizontal force A caused by operation of the
10 piston cam 41'. Thus, horizontal movement of the piston 25' owing to operation of the piston cam 41' is prevented by contact between the bridge cam 38' and the piston 25' and, straight downward movement of the piston, coaxial with the cylinder, is achieved.

15 The piston assembly of both examples is thus provided with a horizontal displacement preventing mechanism to maintain alignment between the axes of the piston and cylinder. The sealing between the cylinder and piston is thus positively retained
20 during the extraction operation.

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CLAIMS

1. A beverage brewing apparatus comprising a frame;
a vertically movable cylinder member supported by the
5 frame and having an open top and an open bottom; a
piston member disposed in the cylinder and supported
for vertical movement on the frame via supports;
means for facilitating entry of hot liquid into the
cylinder below the piston; a base assembly including
10 a brewing cavity which is reciprocatable horizontally
beneath the cylinder member between a brewing
position and a discharge position and being sealed to
the cylinder member in the brewing position; a
camshaft driven by a motor; a plurality of cams on
15 the camshaft; a first cam follower coupled to the
piston; a second cam follower coupled to the
cylinder, each cam follower being in contact with a
respective one of the cams so that the piston and
cylinder members are moved by operation of the cams
20 through the cam followers; and a mechanism separate
from the piston member, but connected therewith, for
ensuring that, when the piston member is moved
downwards, a horizontal component of the force
received by the first cam follower and tending to
25 produce a horizontal movement of the piston member
and a displacement of the axis of the piston member
from that of the cylinder member is resisted.

2. An apparatus according to claim 1, wherein the
30 mechanism for resisting the horizontal force
component comprises a centering roller rotatably
mounted on the piston member together with the first
cam follower, and a guide element disposed on the
frame and facing the centering roller which rolls
35 along the surface of the guide element.

3. An apparatus according to claim 1, wherein the
piston member comprises a cylindrical portion, which



is slidably disposed within the cylinder member, and a U-shaped bridge portion which is fixed to the cylinder^{rical} portion and operatively connected with the frame; the mechanism for resisting the horizontal force component comprising an outer peripheral portion of that one of the cams, which cooperates with the second cam follower, contacting an inner surface of the U-shaped bridge portion.

4. A beverage brewing apparatus, substantially as described with reference to Figures 2 to 7, or to Figures 2 to 7 when modified in accordance with Figure 8, of the accompanying drawings.

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