(57) Abstract: An improved boiler group is designed for use in machines for the preparation of espresso coffee that use pre-packed disposable quantities in the form of a capsule 1 or a pod 1a. The group 100, 200 includes: a heating element 10, 20 with high thermal capacity; a pressurized water supply channel 12, 22 for the preparation of said coffee, situated inside said heating element 10, 20 and opening outside in a position corresponding to an infusion area 15, 25; means 30, 60 for locking said capsule 1 or pod 1a, situated in a position corresponding to said infusion area 15, 25 and allowing the water to pass from said supply channel 12, 220 towards said capsule 1 or pod 1a, and also to convey the coffee going out from the latter towards an outlet channel 13, 23 and then towards a nozzle group. In the boiler group 100,200 the locking means 30, 60 are made move at least partially between a rest position A, AI, for allowing introduction of a capsule 1 or a pod 1a, and an operative position B, BI, for enclosing hermetically and locking said capsule 1 or pod 1a. The above mentioned movement is obtained by the action of the pressurized water used to make the coffee.
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PERFECTIONED OPERATING GROUP FOR ESPRESSO MACHINES

BACKGROUND OF THE INVENTION

The present invention relates to the technical field concerning production of automatic coffee machines.

In particular, the invention concerns an improved boiler group, aimed at being used in automatic infusion coffee machines, which use pods or capsules made of plastic material, containing predetermined quantities of ground coffee for preparation of espresso coffee.

BRIEF DESCRIPTION OF THE KNOWN ART

It is known that conventional automatic coffee machines of this type include a boiler group, contained in a box-like body, aimed at heating continuously water for the preparation of coffee.

The boiler group usually includes a metal heating block, having high thermal inertia, heated by an electrical resistor, and run across internally by a channel, long enough to allow water running therethrough to reach optimal temperature for coffee preparation.

Water is supplied to the channel by an electric pump, which takes water from a suitably provided tank, and goes out from the heating block, at predetermined temperature and pressure, at a point corresponding to an infusion chamber aimed at receiving a capsule or pod containing ground coffee. The so obtained espresso coffee goes out from the infusion chamber and is conveyed towards an outlet nozzle.

The above mentioned infusion chamber must have an excellent wet seal to avoid leaks during operation, and must allow at the same
time an easy access for loading and removing the capsules or pods.

These purposes can be obtained for example by known solutions, which provide a completely removable group including an infusion chamber and nozzle/s for delivering coffee. The group is connected to the remainder of the machine by a bayonet coupling and is removed and re-mounted with a new pod each time a cup of coffee is to be prepared.

Other known solutions provide for a fixed infusion chamber, with an opening system having suitable seals. In these machines, the pod or capsule is inserted into the infusion chamber, which is then closed tightly before infusion starts.

The first system is somewhat difficult to use, especially if the coffee machine is located in an office, or anyway in a room, where it is used by many persons. In these cases there is also a risk that minimum hygienic conditions are not always maintained, or that parts of the delivery group may be lost.

The second system is complicated to manufacture, since mechanisms are necessary for ejecting or removing the used pod or capsule, and moreover, the seals aimed at making the infusion chamber tight can, in time, become deformed and weaken, thus causing leakage of liquid at high temperature and drops of pressure during infusion.

**OBJECTS OF THE INVENTION**

An object of the present invention is to propose an improved boiler group for espresso coffee machines, of the type using disposable pods or capsules, which is capable of overcoming the above mentioned drawbacks by proposing an infusion and delivery mechanism, which has no seals and is easy to produce.
Another object of the invention is to propose a boiler group particularly suitable to operate in environments, in which there is no 230 Volt AC voltage from the main supply network, such as boats, campers or anyway in any particular situation, in which only a low voltage is available.

**SUMMARY OF THE INVENTION**

The above mentioned objects are wholly obtained, in accordance with the contents of claims, by an improved boiler group, including: a heating element with high thermal capacity; a pressurized water supply channel for the preparation of the coffee infusion, situated inside the heating element and having an opening at an infusion area; means for locking a capsule or pod, situated in a position corresponding to the infusion area and aimed at allowing the water to pass from the supply channel outlet towards the capsule or pod, and also to convey the coffee going out from the latter towards an outlet channel and then towards a nozzle group.

In the boiler group, the locking means move at least partially between a rest position A,A1, in which they allow introduction of a capsule or pod, and a in-operation position B,B1, in which they contain hermetically and lock said capsule or pod. The above mentioned movement is obtained by action of the same pressurized water used to prepare coffee.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The characteristics of the invention, as will result from the claims, are pointed out in the following detailed description, with reference to the enclosed figures, in which:

- Figure 1 is a schematic perspective view of a boiler group
for espresso coffee machines obtained according to a first embodiment of the present invention;

- Figure 2 is a lateral section view of the boiler group of Figure 1;

- Figure 3a is a section view of the boiler group of Figure 2 taken along the section plane III-III, in a first variant;

- Figure 3b is a section view of the boiler group of Figure 2 taken along the section plane III-III, in a second variant;

- Figure 4 is a section view of the boiler group of Figure 2 taken along the section plane IV-IV;

- Figure 5a is a top section view of the boiler group of Figure 1, in a operation step for infusion preparation;

- Figure 5b is the same view as Figure 5a, during such infusion operation step;

- Figure 6 is a schematic side view of a boiler group obtained according to a second embodiment of the present invention, in a rest position;

- Figure 7 is a section view of the same boiler group taken along the section plane VII-VII of Figure 6, in an infusion operation step.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

With reference to Figure 1 and to a first embodiment of the invention, reference numeral 100 indicates a boiler group as a whole, aimed at operating in an espresso coffee machine using pre-packed disposable capsules 1. The latter are generally single-dose, but they can also contain enough ground coffee to prepare two or more cups of
coffee.

The boiler group 100 includes in particular a high thermal capacity heating element 10, preferably made of a suitable metal alloy. The dimension and the outer shape of the heating element 10 are designed for installation and use in a special type of espresso coffee machine.

The heating element 10 is provided, in its rear part, with a seat aimed at housing heat generating means 11, conventionally made of a linear "U"-like electric resistor (see Figures 4, 5a and 5b).

The linear resistor 11 is supplied with the network voltage of 230 Volt, and has enough power to bring and keep the heating element 10 at a suitable selected operation temperature. Such power is usually of 700-800 Watt, but it can be bigger for boiler groups of bigger dimensions.

According to the present invention, there is a version of the above mentioned heat generating means, usable as an alternative to the above mentioned linear resistor 11. According to this version (see Figures 1 and 4), the above mentioned heat generating means 21 include one or more low voltage incandescent lamps, of the type commonly used for the illumination of domestic environments. One or more corresponding seats 21a are made in the heating element for housing of the above mentioned lamps 21. Since the electric power absorbed by the lamps 21, and consequently the thermal power delivered by them, is usually less than the one delivered by the linear resistor 11, the time used by the lamps to bring the heating element 10 to the operation temperature is definitely longer. However, in this way it is possible to obtain considerable advantages deriving from the use of the coffee machine in environments, in which no network voltage is available, but only low cc voltage of 12 or 24 Volt, as for example on boats, in campers, in trailers or even in cars.
A channel 12 for supplying pressurized water is provided inside the heating element 10 for the preparation of espresso coffee. The supply channel 12 opens in the upper part of the front wall of the heating element 10, in a position corresponding to an infusion area 15 aimed at housing the capsule 1. In particular, the initial part 12a of this supply channel 12 presents a helical shape (see Figures 1 and 2), so as to increase the distance the water to be heated must run inside the heating element 10.

More precisely, the initial part 12a of the supply channel 12 is made in the form of a groove dug in the lateral surface of a cylinder 16, inserted removably in a relative cylindrical compartment 17, made in the lower part of the heating element 10.

The cylinder 16 is fastened to the heating element 10 by a slight interference or by a threaded fit in correspondence to the lower portion thereof, and wet seal is ensured by a ring-like seal 18 provided in its own housing made in the lower part of the cylinder 16.

A second through channel can be advantageously provided, if required, inside the heating element 10, aimed at allowing the passage of a second liquid, for example milk, to be heated independently from the pressurized water, and to be delivered independently from coffee obtained therefrom.

In order to pressurize water and, in case, milk necessary for its operation, the espresso coffee machine has also one or more pumps of known type, not shown, which will not be described as they are not relevant to the invention.

The boiler group 100 includes also means 30 for locking the capsule 1 (Figures 1, 2, 5a and 5b), situated at the above mentioned infusion area 15 and aimed at receiving sealingly the same capsule 1, so as to allow passage therethrough of the hot pressurized water,
necessary to obtain the infusion, coming from the supply channel 12, and at conveying the so obtained coffee towards a nozzle, not shown.

In the above mentioned first embodiment of the invention the locking means 30 include a piston 31, housed sealingly and sliding between a rest position A (Figures 2 and 5a) and a in-operation position B (Figure 5b), in a cavity 2 made in the heating element 10 at the outlet of the supply channel 12. The tightness is ensured by a suitable seal 3 housed in a suitable seat, made in the cavity 2. The piston 31 is aimed at being brought from the above mentioned rest position A to in-operation position B due to the action of pressurized water that goes out from the supply channel 12, in a manner described in detail later on.

In correspondence to the piston 31 axis, there is a passage channel 32 for the pressurized water, arranged substantially in alignment with the outlet of the supply channel 2. The thickness of the piston 31 is such that, when it is in the rest position A, its outer face is flush with the lateral wall of the heating element 10.

In the outer face of the piston 31 there is also made a cavity 4, aimed at housing a ball valve 32a, of the type normally closed, in correspondence to the outlet of the passage channel 32. The ball valve 32a is kept in closed position by an axial compression spring, gauged so as to allow the pressurized water to pass from the passage channel 32 to the infusion area 15 after the arrival of the piston 31 to the in-operation position B.

A lateral guide 37, fastened to the outer face of the piston 31 (see also Figure 3A), is aimed at guiding the inlet of the capsule 1 to the infusion area 15 and at conveying its subsequent outlet towards an underlying channel 37a, and then towards a waste receptacle.

The heating element 10 has also, fastened thereto, an outer shaped plate 34, in an opposite position with respect to the lateral face
of the same heating element 10 and at a suitable distance therefrom. This distance is defined by a couple of threaded stems 35 and corresponding spacers 35a.

A rear abutment element 36, also fastened to the outer plate 34, has a cylindrical shape and is arranged substantially aligned with the piston 31. Therefore, the latter and the rear abutment 36, together with the upper part of the lateral guide 37, define the above mentioned infusion area 15.

The rear abutment 36 has an inner portion 36a of slightly smaller diameter, which receives slidably and coaxially a tubular member 39. The latter is mounted externally to the rear abutment 36 and slides against the action of return springs 40 between a rest position C, in which the tubular member 39 superimposes completely the inner portion 36a, and a in-operation position D, in which the same is put forward up to cover the portion of the infusion area 15 occupied by the capsule 1.

An outlet through channel 13, made on the axis of the rear abutment 36, is aimed at receiving the coffee going out from the infusion chamber 15 and at conveying it towards a nozzle group, not shown.

The piston 31 is kept in its rest position A by first elastic means 33, formed substantially by a pair of helical springs, mounted coaxial on respective guiding stems 33a, having one end fastened to the piston 31 lateral with respect to the infusion area 15, and the opposite end free to slide in related holes made in the outer plate 34. The springs 33 go in abutment against the inner wall of the plate 34 and a pair of spacers 33b of the length that allows the necessary excursion of the piston 31.

A pair of re-entrant springs 38, situated between the infusion area 15 and the channel 37a, are aimed at supporting temporarily the
capsule 1 in the infusion position, that is substantially in axis with the piston 31 and with the rear abutment 36.

In a first version, shown in Figure 3A, these springs are fastened to the piston 31 and penetrate into the lateral guide 37. In a second version, shown in Figure 3B, there are springs 38a fastened to the inner wall of the same lateral guide 37.

According to the first embodiment described above, the operation of the boiler group 100 includes the introduction of a disposable capsule 1 of ground coffee from above (arrow of Figure 2) into the infusion area 15 defined by the lateral guide 37, the rear abutment 36 and the piston 31, which is kept in its rest position A by the action of the springs 33.

The heating element 10 has been previously brought to the operation temperature by activation of the linear resistor 11 or, in the above described version, by turning on the incandescent lamps 21.

At this point, the user who wants to prepare a cup of coffee makes manually the tubular member 39 slide from its rest position C to the in-operation position D (Figure 5A), in which it contains the capsule 1.

Afterwards, the user operates the pump that conveys pressurized water towards the supply channel 12.

The water is heated up to a temperature effective for infusion in the first helical portion 12a of the channel 12 and then it occupies the final portion of the channel. The action of water going out of the above mentioned channel overcomes the elastic contrast of the springs 33 and makes the piston 31 slide until it pushes the capsule 1 against the rear abutment 36 (Figure 5B). Therefore, the capsule 1 is pack closed between the piston 31 and the rear abutment 36. The smooth surface of the above mentioned elements ensures the tightness of the fit.

In the meantime, the pressurized water has penetrated in the passage channel 32 of the piston 31 and has reached the ball valve
32a. The resistance of the spring present in the latter is overcome by the pressure of water, which can consequently penetrate into the capsule 1. The infusion of coffee goes out of the capsule 1 and is then conveyed towards the outlet channel 13 and towards the subsequent nozzle.

The interruption of the pump action produces, in an entirely known way, a drop in the water pressure, which makes the ball valve 32a close and the piston 31 return to its rest position A. The cylindrical element 39 is then brought manually to its rest position D, with the help of the return springs 40.

In this case the capsule 1 is not ejected immediately, but it is pushed towards the channel 37a by the action of the subsequent capsule, which is introduced afterwards for the preparation of another coffee.

A second embodiment of the invention, shown in Figures 6 and 7, includes a boiler group 200 comprising locking means 60 structured in a different way than the ones described for the first embodiment.

In particular, the above mentioned locking means 60 include, quite similarly to what has been described above, a heating element 20, provided with a supply channel 22, which opens into an infusion area 25. An initial part 22a of the channel 22 has a helical conformation, and is made in the form of a groove dug in the lateral surface of a cylinder 26, inserted removably in a relative cylindrical compartment 27, made in the lower part of the heating element 20.

The latter includes also a crown 61, substantially circular and open upwards, made in correspondence to the infusion area 25 to delimit the border thereof, and centered with respect to the outlet of the supply channel 22. The upper opening allows introduction of a pod 1a into the infusion area 25, in a way that will be better explained later on.
An outer shaped plate 74 is fastened at a suitable distance from the heating element 20, in an opposite position with respect to the lateral face of the same heating element 20. The fastening distance is defined by a couple of threaded stems 75 and corresponding spacers 75a.

A substantially cylindrical support block 62 is fastened to the inner face of the shaped plate 74, in axis with the above mentioned crown 61. The support block 62 is provided internally with a through channel 63, connected with the pump of the espresso coffee machine and aimed at housing pressurized water. Advantageously, the through channel 63 receives pressurized water from the same pump that supplies pressurized water to the above mentioned supply channel 22.

A closing element 64 of the infusion area 25 is associated to the support block 62 and is aimed at containing the pod 1a in cooperation with the aforesaid crown 61 during the infusion operations. More precisely, the closing element 64 includes an outer tubular portion 66 and an inner portion 65, having a coffee outlet channel 23, which opens in position corresponding to the inner face 65a of the same inner portion 65. The tubular portion 66 is arranged coaxial with the support block 62, and is mounted externally thereto and slides between a rest position A1, in which the closing element 64 allows to introduce a pod 1a into the infusion area 25, and a in-operation position B1, in which the outer edge of the pod 1a is closed sealingly in the infusion area 25 between the lateral wall of the heating element 20 and the edge of the inner face 65a of the closing element 64.

The closing element 64 includes also a pair of axial through holes 77,78, in which the above mentioned spacers 75a of the threaded stems 75 are inserted. In this way, the latter serve as a guide to stabilize the closing element 64 sliding.

The closing element is kept in its rest position A1 by second
elastic reaction means 67, formed, in the shown embodiment, by a pair of helical springs arranged coaxial on the aforesaid spacers 75a, between the closing element 64 and the heating element 20.

A space 122 between the outlet of the through channel 22 and the infusion area 25 is aimed at housing a ball valve 125, normally closed, aimed at allowing the passage of pressurized water towards the infusion area 25 only when said closing element 64 has reached its in-operation position B1. In this connection, the ball valve 125 includes a contrast spring 126, gauged so as to operate afterwards with respect to the springs 67 that act on the closing element 64.

The operation of the boiler group 200 of the second embodiment of the invention includes the introduction from the top of a disposable pod 1a of ground coffee (Figure 6) into the infusion area 25 defined by the crown 61, the lateral face of the heating element 20 and by the closing element 64, which is kept in its rest position A1 by the action of the springs 67.

The heating element 20 has been previously brought to the operation temperature by activation of the linear resistor 11 or, in the above described version, by turning on the incandescent lamps 21.

At this point, the user who wants to prepare a cup of coffee operates the pump that conveys pressurized water towards the supply channel 22, heating it up to a temperature effective for infusion.

Contemporarily, the pressurized water is sent also towards the through channel 63 and from there it is conveyed to the space between the support block 62 and the closing element 64. The latter is gradually pushed towards its in-operation position B1 by the action of the pressurized water (Figure 7). Therefore, the pod 1a is pack closed between the wall of the heating element 20 and the edge of the closing element 64. The smooth surface of the above mentioned elements
ensures the tightness of the fit.

In the meantime, the pressurized water, penetrated in the supply channel 22, has reached the ball valve 125. The resistance of the spring 126 present in the latter is overcome by the pressure of the water, that can consequently penetrate in the pod 1a. The coffee infusion goes out from the pod 1a and then it is conveyed towards the outlet channel 23 and towards the subsequent nozzle.

The interruption of the pump action causes, in an entirely known way, a drop in the water pressure, which makes the ball valve 125 close and the closing element 64 return to its rest position A1. Consequently, the pod 1a can be removed manually from the infusion area 25.

It is understood that what above has been described as a pure, not limiting example. Therefore, possible changes and variations of the invention are considered within the protective scope conceded to the present invention, as described above and claimed below.
CLAIMS

1. Improved boiler group for machines for the preparation of espresso coffee that use pre-packed disposable quantities in the form of a capsule (1) or a pod (1a), said group (100,200) including: a heating element (10,20) with high thermal capacity, having heat generating means (11,22), the heating element bringing the temperature of said heating element (10,20) to a prefixed operation value; at least one pressurized water supply channel (12,22) for the preparation of said coffee, situated inside said heating element (10,20) and opening outside in a position corresponding to an infusion area (15,25); means (30,60) for locking said capsule (1) or pod (1a), situated in a position corresponding to said infusion area (15,25) and allowing the water to pass from said supply channel (12,22) outlet towards said capsule (1) or pod (1a), and also to convey the coffee going out from the latter towards an outlet channel (13,23) and then towards a nozzle group; said boiler group (100,200) being characterized in that said locking means (30,60) are made move at least partially between a rest position (A,A1), for allowing introduction of a capsule (1) or a pod (1a), and an operative position (B,B1), for enclosing hermetically and locking said capsule (1) or pod (1a), said movement being obtained by the action of the pressurized water.

2. Boiler group, according to claim 1, characterized in that at least a part (12a,22a) of said supply channel (12,22) has a helical shape and is made in a position corresponding to the lateral surface of a cylinder (16,26), inserted removably in a relative cylindrical compartment (17,27) made in the body of said heating element (10,20).

3. Boiler group, according to claim 1, characterized in that a second
through channel is made in said heating element (10,20), that allows the passage of a second liquid, such as milk, to be heated independently from said pressurized water.

4. Boiler group, according to claim 1, characterized in that said locking means (30) include: a piston (31), housed sealingly in a cavity made in said heating element (10) in a position corresponding to the outlet of said supply channel (12) and having in turn a passage channel (32) for the pressurized water, said piston (31) being kept resting in said position (A) by first elastic means (33) acting against an outer plate (34), fastened to said heating element (10) and kept in a position outer with respect to said locking means (30), and being also brought to said in-operation position (B) by the action of the pressurized water from the supply channel (12); a fixed rear abutment (36), fastened to said outer plate (34) in axis with said piston (31), provided with said outlet channel (23).

5. Boiler group, according to claim 4, characterized in that it includes also a lateral guide (37), fastened to the outer face of said piston (31) and guiding the introduction of said capsule (1) into the infusion area (15) and its subsequent going out from said area, said lateral guide (37) being also provided with a pair of reentrant springs (38), supporting temporarily said capsule (1) in infusion position, substantially in axis with said piston (31) and rear abutment (36).

6. Boiler group, according to claim 4, characterized in that it includes also a tubular member (39), coaxial with the inner portion (36a) of said rear abutment (36) and mounted externally thereto, sliding against the action of the return springs (40) between a rest position (C), in which said tubular member (39) superimposes completely said inner portion (36a), and a in-
operation position (D), in which the same is put forward up to cover the portion of the infusion area (15) occupied by said capsule (1).

7. Boiler group, according to claim 4, characterized in that said piston (31) is provided, in a position corresponding to the outlet of said passage channel (32), with a ball valve (32a), of the normally closed type, which allows pressurized water to pass from said passage channel (32) to said infusion area (15), after said piston (31) has arrived in said in-operation position (B).

8. Boiler group, according to claim 1, characterized in that said locking means (60) include: a crown (61), made in said heating element (20) in a position corresponding to said infusion area (25), which is open in its upper part to allow introduction of said pod (1a) and which delimits the border of the same infusion area (25) and centers the pod (1a) with respect to said area and to said supply channel (22); a support block (62), substantially cylindrical, fastened to said heating element (20) in axis with said crown (61) and from the opposite side of the infusion area (25) with respect to the same crown (61), said support block (62) being also provided with a through channel (63); a closing element (64) of said infusion area (25), for containment of said pod (1a) in cooperation with said crown (61), said closing element (64) including an inner portion (65), having said outlet channel (23) open in a position corresponding to the inner face (65a) of said inner portion (65) and having also an outer tubular portion (66), arranged coaxial with said support block (62) and sliding between said rest position (A1) and said in-operation position (B1) due to action of pressurized water supplied by said through channel (63), and between said in-operation position (B1) and rest position (A1) due to action of second elastic
reaction means (67).

9. Boiler group, according to claim 8, characterized in that between the outlet of said through channel (22) and said infusion area (25) there is a space (122), which houses a ball valve (125) normally closed and allowing the pressurized water to pass towards said infusion area (25) only when said closing element (64) has reached said in-operation position (B1).

10. Boiler group, according to claim 8, characterized in that said through channel (63) receives pressurized water from the same pump that supplies pressurized water to said supply channel (22).

11. Boiler group, according to claim 1, characterized in that said heating element (10,20) has at least another cavity (16) and in that said heating means (21) include at least one low voltage incandescent lamp, that is inserted accurately in said cavity (16) in order to raise the temperature of said heating element (10,20).