



**Device and method for improving the extraction of a
food substance contained in a refill**

5 The invention relates to a device for extracting a food substance for making drinks using a closed refill filled with the food substance and through which a stream of pressurized water passes.

10 The use of predetermined and prepackaged doses in the form of refills containing ground coffee for preparing drinks of the espresso type or the like has many advantages, including those of facilitating the operations of preparing the drink, of ensuring a relatively clean preparation and of controlling a
15 relatively constant dose and quality of the prepared product.

The principle of extraction from closed or sealed refills consists in: (i) enclosing the refill in a
20 sealed chamber, (ii) piercing one face of the refill, (iii) introducing a quantity of hot water into the refill so as to create a pressurized environment inside the refill in order to produce the coffee extract, (iv) then releasing the coffee extract through the opposite
25 face of the refill which, in contact with projecting parts of the device, opens under the effect of the internal pressure.

30 There are already devices for extraction from capsules or cartridges, comprising a housing for the cartridge to be extracted and a point such as those described in patent CH 605 293 and EP 242 556. In these devices, the point has a dual function. On the one hand, it opens the upper part of the capsule and, on the other hand,
35 it forms the inlet channel for water in the sense that the water is directly introduced inside the capsule through the point itself. One drawback of such a device arises in that the hole obtained by a single needle has



the effect of creating, at the beginning of the extraction, a preferred pathway through the mass of coffee to be extracted without completely wetting it. The consequence of creating a preferred pathway is that
5 when the extraction takes place, the rate at which the pressure rises becomes too high which may lead to releasing the extract too early such that not enough extraction time is obtained. Of course, the consequence may be a loss of solids and flavours which then remain
10 fixed in the grounds and are therefore not transferred to the extract. Another drawback arises in that the point tends to get blocked quickly because of the scale in the water or contact with the grounds, which may affect the performance of the device. Given the large
15 size of the hole made in the capsule, the capsule is also subject to undesirable rise of the grounds and the liquid residue after use.

Document EP 0 604 615 B1 also relates to a device which
20 has means of perforating a flexible sachet containing the product to be extracted which is in the form of a grid for distributing water provided on its lower face with elements having projecting points, blades or crosses. Orifices may be provided for the passage of
25 water through the distribution grid at each perforating means. Thus an improvement in the water distribution in the sachet is provided which makes it possible to improve the wetting of the mass to be extracted. However, the orifices with a closed section can fur up
30 over time with consequences concerning the control of the flow rate and pressure during the extraction.

Document US 5,794,519 relates to an extraction device comprising an extraction head which supports movable
35 needles by means of an ejector which ejects the capsule from the needles by means of a spring when the extraction head is in the open position. Such a construction is relatively complex. Furthermore, it requires providing openings with a closed section for

the passage of water either through the plate supporting the needles or through the needles themselves, which leads to problems of reduction of the orifices, and blocking or furring up on intensive use
5 of a device. Over time, the flow rates, the through pathways, the volume of water and other parameters relating to the extraction conditions, in particular the extraction pressure, the extraction time and the temperature, undergo significant alterations which
10 impair the quality of the extract produced.

The present invention aims to improve the design of the elements piercing a closed refill of the capsule or sachet type or the like which enhances the flow
15 conditions of the water inside the refill and improves the conditions for extraction. More specifically, the invention aims to improve the spraying of water through the substance to be extracted by avoiding preferred pathways and by providing a relatively slow pressure
20 rise inside the refill in order to optimize the capture of the flavours. The object of the invention is also to remove the risk of reducing the flow because of obstructions formed by scale deposit or the like. It provides a constant flow over time independent of the
25 obstruction factors. It enhances the release of the capsule from the piercing means but avoid using forced ejection systems. The object of the invention is also to provide a piercing, more specifically a cutting, configuration guaranteeing a flow of water which is
30 relatively reproducible from one refill to another which takes account of variations due to dimensional tolerances between the housing of the device and the refills. The invention also aims to limit the rise of liquid or solid residue outside the refill after
35 extraction. The object of the invention is also to guarantee cleaner opening by the piercing elements without a risk of detaching material from the wall of the refill.

To do this, the device according to the invention comprises a hollow body for accommodating the refill, a water inlet channel passing through the said body and communicating in the housing and a plurality of
5 piercing elements arranged in the housing for piercing the refill in several different places in order to allow the water to pass through the refill. Improving the device provides for the piercing elements to be spaced apart in the housing with respect to the water
10 inlet direction. Furthermore, each piercing element comprises a base portion which is secured to the body and projects into the housing. The base portion is designed to engage at least partially inside the refill so as to form a flow surface for the water. The base
15 portion is intersected by a cutting surface at an acute angle forming a bevelled cutting portion. The base portion is also without a flow channel having a closed section which can easily be obstructed by grounds or fur. On the contrary, the flow inside the capsule takes
20 place mainly through a space owing to the fit [sic] that forms between the surface of the base portion and the opening cut in this way. Such a space is therefore temporary since it is created only by the cutting or piercing as the refill is put in place in the housing.
25 Thus the formation of residues, which may alter the flow conditions, is avoided.

Such a configuration of the piercing elements also has the effect of improving wetting of the substance to be
30 extracted by reducing the preferred pathways, allows a slower pressure rise inside the refill and therefore improves the quality of the liquid extract obtained. More specifically, the cuts are thus made with better definition and better geometry of the openings. In
35 particular, openings are obtained that are closer together around the piercing elements. This has the consequence that, at the start, the water flows more slowly through the refill thereby avoiding the formation of preferred pathways, and also the

consequent rise in pressure takes place more slowly. Unlike a single point, the piercing element according to the invention does not create a foldover of material over the entire opening, which tends to enlarge it, but
5 on the contrary, the piercing element cuts cleanly and releases the cut material only on the side of the cutting surface, thus producing an improved definition of the opening and therefore a beneficial effect on the rate at which the internal pressure rises.

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Preferably, to obtain openings having good definition, the cutting surface of the piercing element forms a cutting angle of between 10 and 50°, and even more preferably, 15 and 45°, with respect to the
15 longitudinal direction of the base portion.

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Preferably, the base portion has a cross section which gradually decreases in the direction of the cutting surface at an angle smaller than the angle of the cutting surface which makes it possible for the enlargement of the opening to be more accurately controlled and thus to ensure that the material remains as close as possible to the base portion as the piercing element is gradually introduced into the
25 refill, then guaranteeing a slower pressure rise and therefore a better quality extraction. Because of the fit between the capsule and the piercing elements, the decreasing shape of the base portion also ensures easier retraction of the capsule after the extraction
30 and avoids using an ejection device.

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The shape of the base portion is not limiting. However, it is preferable for the base portion to have a cross section such that the ratio of its largest dimension to its narrowest dimension is between 2/1 and 1/1 so as to produce localized openings in the form of holes rather than notches. Thus, the base portion may have a cross section of circular, ellipsoidal, rectangular, square,

triangular or other regular or irregular polygonal shape.

Preferably, the base portion form a cone portion with
5 an angle of between 1 and 10°, preferably 3 and 5°,
which is intersected by the cutting surface. Thus, the
opening is enlarged in a gradual and controlled manner
around the piercing element and the risk of tearing is
decreased.

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It has also been possible to note that the orientation
of the piercing element, and especially its cutting
surface, in the housing is of importance to the
cleanness of the cut. Thus, the piercing elements are
15 preferably oriented in the housing so as to present
their cutting surface respectively at an angle close or
equal to 90° with respect to the surface of the refill
to be cut when the latter is engaged in the housing. In
other words, the angle of attack is oriented so as to
20 be a maximum thus promoting a higher-performance cut.

Of course, the nature and the geometry of the refill
may cover many variants. In general, the body of the
device has a housing of shape and dimensions suitable
25 for accommodating one or more types of refill. The
refill may be a rigid, semi-rigid or flexible element
comprising a substance to be extracted which may or may
not be in compacted form. By way of example, the type
of refill is a leaktight, sealed capsule or cartridge,
30 comprising a dish substantially in the shape of a
truncated cone and a lower face forming a lid sealed on
the lower edge of the dish like the one forming the
subject of patent EP 512 468, whose content is included
here for reference. According to another possible
35 variant, it may involve a flexible sachet formed from
two flexible sheets welded together over their
perimeter and comprising a compacted portion of
substance to be extracted. Such a sachet configuration

is described in patents US 6 025 000 and US 6 068 871 included here for reference.

5 The body of the device for receiving the refill according to the invention may be part of a complete assembly of the espresso coffee machine type or the like. The body may be an integral part of the device or be a part attached by screws or other means. The body is in general commonly called a "capsule cage". In
10 general, the body of the device cooperates on closing with a complementary lower closure part comprising means for breaking the lower part of the refill for the flow of the extract produced during the extraction operation. According to the invention, the body and the
15 lower closure part cooperate on closure according to a principle of jaws which can move in a direction substantially corresponding to the direction of the piercing elements in the housing so as to avoid any risk of tearing the refill. A device with movable jaw
20 of this type is described in patent application EP 0 604 615 or else in as yet unpublished patent application EP No. 99117107.5 of 31.08.1999 in the name of the applicant; the complete contents of both applications are also included here for reference.

25 Finally, the invention also relates to a method of extracting a food substance contained in a refill by piercing the refill in several different places so as to allow pressurized water to pass through the refill.
30 The piercing is carried out by cutting using a cutting portion of the piercing element at several different places in the refill and by creating, at each place, a temporary flow surface between a base portion of the piercing element and the cut opening.

35 The rest of the description is made with reference to the drawings in which: -

Figure 1 shows an exploded view of an extraction device according to a preferred embodiment;

5 Figure 2 shows a sectional view more particularly of the piercing and water-supply device according to the invention;

Figure 3 shows, in section, a preferred arrangement of the piercing elements secured to a mounting support;

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Figure 4 is a view of figure 3 in perspective;

Figure 5 shows the principle of cutting using a piercing element of the invention.

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In the present application, the term "capsule" may be used to denote the refill. However, it must not be interpreted in a limiting manner and may include any type of rigid, semi-rigid or flexible refill.

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With reference to Figure 1, the extraction device 1 according to the invention is in the form of an extraction assembly capable of accommodating a refill 5, in this instance in the example illustrated, a semi-rigid capsule containing a substance to be extracted such as a predosed quantity of ground and roasted coffee. More specifically, the extraction assembly comprises a capsule cage forming a hollow body 2 provided with a housing 3 and a lower support 4 capable of cooperating with the capsule cage 2 when closed around the refill 5. The capsule cage 2 and the lower support 4 may be closed by any suitable mechanical means, but preferably, by relative mobility in a substantially vertical, straight or slightly curved direction, of trajectory O. By way of example, the lower support 4 may be static in the direction O in order to accommodate the refill 5 and the capsule cage may be movable in the direction O in the closed position. Alternatively, the lower support could also

be provided so that it can move along O, the capsule cage being fixed or else movable along O.

5 The capsule cage 2 is extended upwards by an upper portion 20 having connection means 21 such as an external thread enabling connection to a hot-water supply. The upper portion 20 has an internal bore 22 for the passage of water, which communicates with the housing 3 of the hollow body at a water outlet 23.

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The lower support 4 comprises a distribution plate 40 for accommodating the base of the capsule, generally consisting of a flexible sheet 50. The distribution plate comprises, distributed over its inner surface, 15 relief elements 41 designed to cause the opening by multiple tearing of the flexible sheet under the effect of the extraction pressure inside the capsule. A subassembly 42 is provided downstream of the distribution plate, for flow of the liquid extract 20 obtained, after the base of the capsule is broken, and ends in an outlet orifice 43.

The refill has a sealed peripheral edge 51 gripped between the capsule cage 2 and the lower support 4. The 25 gripping closure is achieved in a sealed manner by contact between the edges of the cage and of the support. Sealing means for the cage, such as an elastomer ring 52, may be provided to ensure a firm and elastic grip between the parts in contact, thus 30 avoiding any risk of leakage when the housing is pressurized. The mechanical means closing the assembly and holding it in position are not illustrated here. This may, for example, involve means of the articulated lever type with manual or motorized control.

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As shown more specifically in Figure 2, a series of piercing elements 6 is provided at the bottom of the housing 3 in order to cut the top of the capsule with a plurality of holes and to allow water to pass through

the capsule. The piercing elements 6 are regularly distributed around the central water inlet and project towards the inside of the housing in a direction substantially parallel to the direction in which the capsule engages in the housing. Preferably, the elements are mounted securely to a common mounting support 60 allowing fast mounting inside the housing. The mounting support may include a hollow rod portion 62 having an external thread 63 which is screwed into a complementary threaded portion of the water inlet channel. The piercing elements may be mounted by screws 64 on the support 60. Alternatively, the piercing element could be welded to the support or form an integral part of the support.

As shown in Figure 3, each piercing element 6 comprises a base portion 65 oriented in a longitudinal direction I corresponding to the direction of engagement in the refill. The base portion is interrupted by an inclined surface 66 which forms the cutting surface of the element. The angle of inclination A of the cutting surface with respect to the direction I is preferably between 10 and 50°, better still between 15 and 45°. The surface 66 mainly has a cutting function as illustrated in Figure 5 with the advantageous effect that the sliver of material 53 is cleanly cut and is released in one piece on the side on the bevelled part 66. Thus, tearing as with a point is avoided, where the material tends to move away in several directions creating tear lines over the perimeter of the hole.

The base portion may advantageously be a cone portion with a cross section tapered in the direction of the cutting surface. Such a shape is advantageous since it makes it possible to guarantee keeping a minimum clearance between the surface of the base portion and the edge of the hole. Thus a too sudden re-entrance of water is prevented, which would have the consequence of creating preferred pathways through the mass to be

extracted and therefore, consequently, generate too rapid an increase in pressure. Such a clearance is also temporarily created for the duration of the extraction. Thus any deposit of residues on the surfaces is avoided. The surface of the base portion is scraped by the capsule surface on entry and exit of the piercing element, which provides constant cleaning of the flow surface and removes any possible deposit. From one capsule to another, the piercing conditions remain identical as do the flow conditions. A truncated cone shape of this sort is also advantageous compared to a shape with a constant cross-section in particular when the device is closed in a substantially arced trajectory as shown in Figure 1 in that a constant cross section would have the effect of widening the hole on the outside of the curve and therefore of creating an undesirable clearance.

In the example illustrated, the refill expands relatively little during pressurization such that a passage 30 is maintained between the wall of the housing and the wall of the refill 5. Thus, the base portion 65 has to be long enough, about 2 to 15 mm, that when the refill is engaged in position in the housing, the cutting surface 66 is positioned completely inside the refill chamber, and this while taking account of the possible variations of the passage thickness due to the dimensional tolerances between the housing and the refill.

As shown in Figure 2, each piercing element is individually oriented in the housing such that its cutting surface 66 makes an angle of $90 \pm 5^\circ$ to the surface to be cut. Thus, better cutting and less wear of the cutting surface is obtained.

The piercing elements may be made of a suitable hard and wear-resistant material. The material is chosen depending on the material of the capsule or sachet to

be cut. In general, the capsules are made of thin aluminium or of plastic with a thickness of 0.2 to 1.5 tenths of a millimetre such that the piercing elements may be made of metal, preferably, hard-layer anodized aluminium or stainless steel, or of ceramic or hard plastic.

The number of piercing elements may of course vary according to the size of the refills. Enough of them are needed in order to correctly distribute water through the mass without however weakening the wall of the refill too much, which could then break and thus soil the housing. Thus, the number of piercing elements is preferably between 3 and 10, preferably 4 and 6. The number of piercing elements depends on the cross section of the elements. Too great a number of elements with a large cross section tends to create deformations in the surface of the capsule, damaging the latter. The largest transverse dimension of the base portion (for example, its diameter for a portion of circular cross section) is preferably less than 3 mm, even more preferably between 1 and 2.5 mm. For a base of around 2.4 - 2.5 mm, the number of elements should not exceed 3 or 4. On the other hand, for a base of about 1 to 2 mm, the number of elements may go up to 6, or even 8, without significant deformation of the capsule and thereby guaranteeing optimum extraction conditions (time, pressure, temperature).

In a possible configuration, each piercing element may be provided with an open groove longitudinally distributed along the surface of the base portion making it possible to refine the water flow in a controlled way. The groove is preferably placed on the side of the end of the cutting surface such that the surface is sufficiently free.

In the example shown, the method for extracting a liquid is as follows. The device is in the open

position and a capsule 5 is placed on the relief surface of the lower support 4. The device is reclosed by applying the edges of the cage 2 and of the support 4 so as to pinch the sealing edge 51 of the capsule. On
5 closure, the upper surface of the capsule is cut by the piercing elements 6. In this position, a significant part of the base portion of each element is inserted into the capsule so as to offer a flow surface during the extraction time. The hot water runs into the
10 housing via the exit 23 and is distributed in the passage 30 then flows slowly between the surface of the piercing elements and the cut edges of the openings. As the water gradually enters, the pressure inside the capsule slowly increases which tends to slightly dilate
15 the holes in a uniform manner around each element. The pressure for tearing the base of the capsule reaches about 7 to 9 bars in a few seconds. The tensile force for breaking the sheet of the capsule is then reached and the extracted liquid can be removed through the
20 flow part 42 and through the hole 43.

The invention has been described by way of preferred example in relation to a device for extraction from semi-rigid capsules having a limited deformability.
25 However, it is understood that the invention is nevertheless applicable for extraction from flexible refills of the sachet type comprising a compacted mass of an extractable food substance.

Claims:

1. Device for extracting a food substance contained
in a closed refill, the said device comprising a
5 hollow body provided with a housing for
accommodating the refill, a water inlet channel
passing through the said body and communicating
with the housing, a plurality of piercing elements
arranged in the housing for piercing the refill in
10 several different places in order to allow the
water to pass through the refill, characterized in
that
the piercing elements are spaced apart in the
housing with respect to the water inlet direction
15 in the housing and in that,
each piercing element comprises:
(i) a base portion secured to the body and
projecting into the housing; the said base
portion being designed to engage at least
20 partially inside the refill so as to form, in
combination with the cut opening of the
refill, a space for the passage of water
inside the capsule, the base portion forming
a solid element with no flow channel having a
25 closed cross section,
(ii) a cutting surface which intersects the base
portion at an acute angle.
2. Device according to Claim 1, characterized in that
30 the base portion has a cross section which
gradually decreases in the direction of the
cutting surface at an angle smaller than the angle
of the cutting surface.
- 35 3. Device according to Claim 1 or 2, characterized in
that the cutting surface forms a cutting angle of
between 10 and 50°, preferably 15 and 45°, with

respect to the longitudinal direction of the engaging portion.

- 5 4. Device according to Claim 1, 2 or 3, characterized in that the base portion forms a portion of circular, ellipsoidal, regular or irregular polygonal cross section.
- 10 5. Device according to Claim 4, characterized in that the base portion forms a cone portion with an angle of between 0 and 10°, preferably 3 and 5°.
- 15 6. Device according to any one of the preceding claims, characterized in that the elements are oriented in the housing so as to present the cutting surface at an angle close or equal to 90° with respect to the surface of the refill to be cut when the latter is engaged in the housing.
- 20 7. Device according to any one of the preceding claims, characterized in that the base portion comprises, on its outer surface, at least one open groove oriented longitudinally in order to make it easier to introduce water into the refill.
- 25 8. Device according to any one of the preceding claims, characterized in that the water inlet channel is located centrally in the housing and in that the piercing elements are distributed regularly in an off-centre manner around the channel.
- 30 9. Device according to Claim 7 or 8, characterized in that the number of piercing elements is between 3 and 10, preferably 4 and 6.
- 35 10. Method of extracting a food substance contained in a refill by piercing the refill in several different places so as to allow pressurized water

5 to pass through the refill, characterized in that the piercing is carried out by cutting using a cutting portion of the piercing element at several different places in the refill and by creating, at each place, a temporary flow surface between a base portion of the piercing element and the cut opening.