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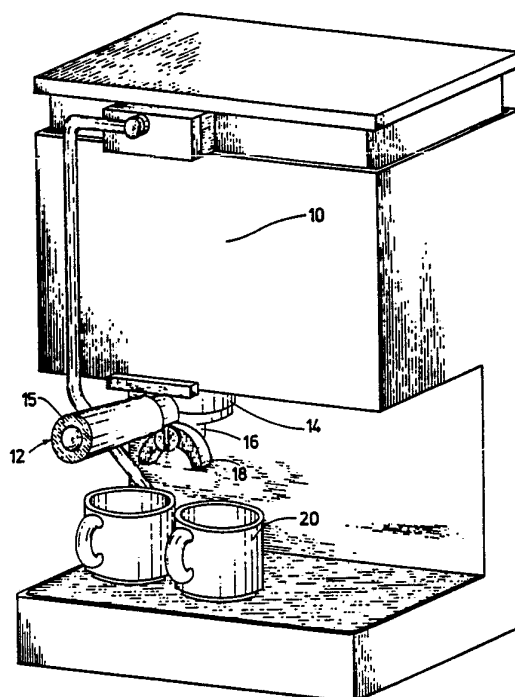
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Published*With international search report.**With amended claims and statement.*

(54) Title: IMPROVED APPARATUS AND PROCESS FOR EXTRACTING ESPRESSO COFFEE

(57) Abstract

An improved process and apparatus for the extraction of espresso coffee from ground coffee beans in which the pressure of extraction is precisely regulated by a pressure valve (16) and is not dependent on coffee grind size, degree of compaction of the coffee grind, or operator skill. A feature of the invention is in an assembly of the brewing chamber (44) and regulator valve (48) for convenient removal and attachment to an espresso machine (10) as a unit (40) without otherwise modifying the machine. The assembly (40) is configurable with the regulator valve (48) within a common housing (41) which also defines the brewing chamber (44), or with a regulator valve (35) separate from the brewing chamber assembly (28) but attached to an outlet (33) of the brewing chamber (28).



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1 IMPROVED APPARATUS AND PROCESS FOR
2 EXTRACTING ESPRESSO COFFEE

3
4 BACKGROUND OF THE INVENTION

5
6 Related Application

7
8 This is a continuation-in-part of copending patent
9 application Serial No. 07/283,243 filed December
10 12, 1988 entitled IMPROVED PROCESS FOR EXTRACTING
11 ESPRESSO COFFEE by HOWARD W. SELBY, III.

12
13 Field of Invention

14
15 This invention relates generally to methods and
16 devices for producing espresso coffee. More
17 particularly, the present invention relates to
18 methods and apparatus for consistently producing
19 high quality espresso coffee from ground coffee
20 beans in a manner that is relatively independent of
21 the skill of the espresso machine operator.

22
23 Description of Prior Art

24
25 Espresso coffee is brewed by forcing hot water
26 through finely ground coffee beans under high
27 pressure which extracts the coffee beverage from
28 the coffee beans. Both the amount of ground coffee
29 beans and water are volumetrically measured. In
30 conventional espresso machines, the coffee beans
31 are finely ground, volumetrically measured and
32 carefully packed manually in a filter device. The
33 filter is thereafter attached to the espresso
34 machine.

35
36 That is, a conventional espresso coffee machine
37 typically employs from 5 to 8 grams per cup of
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1 ground coffee compacted in a device having a filter
2 basket which device is subsequently attached to the
3 espresso machine. Between 25 to 60 ml/cup of
4 heated water is forced through the ground coffee in
5 the filter over a time period range of 15 to 35
6 seconds. The compacted coffee in the filter acts
7 as a restriction to the water flow, resulting in a
8 buildup of water pressure within the filter so that
9 water flows under pressure through the coffee and
10 out an exit hole at the base of the filter.

11
12 Coffee brewing or extraction occurs as the water
13 passes through the compacted coffee. Extraction
14 pressure is a function of the fineness of the
15 coffee grind and the degree to which it is
16 compacted in the filter. Both of these are
17 operator dependent resulting in quality variations
18 in the extracted coffee based on the experience and
19 skill of the operator.

20
21 Hot water is forced through the filter by means of
22 a pump which is operated by hand or by means of an
23 electric pump device. The hot water is forced into
24 the ground coffee beans in the filter. The
25 fineness of the coffee grind and the degree of
26 compaction thereof by the machine operator creates
27 a pressure differential across the ground coffee
28 beans. This pressure differential varies across
29 the ground coffee beans from the highest on the
30 inlet or upstream side of the ground coffee beans
31 to the lowest on the outlet or downstream side.
32 Because of the pressure gradient, not all of the
33 ground coffee beans are subjected to the optimum
34 extraction pressure resulting in extraction
35 inefficiencies which require use of larger volumes
36 of ground coffee beans.

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1 The water, under pressure, is forced through the
2 coffee beans and extracts the coffee from the
3 beans. Extraction time is very short compared to
4 other coffee brewing methods. The extracted coffee
5 drains through an opening in the bottom of the
6 filter and is collected in a cup for consumption.
7 The pressure differential in the filter is directly
8 related to the grind of the coffee beans and the
9 degree of their compaction.

10

11 The quality of the extracted coffee is a function
12 of the following: The freshness and quality of the
13 coffee beans; the fineness of the grind; the volume
14 of ground coffee beans; the compaction of the
15 ground coffee beans; extraction time; the volume of
16 water; the temperature of the water; and the
17 extraction pressure. The degree of compaction of
18 the ground coffee beans and thus the resulting
19 extraction pressure are controlled by the espresso
20 machine operator so operator skill plays an
21 important part in the quality of the coffee
22 produced.

23

24 A discussion of the contemporary espresso coffee
25 and its preparation is contained in the January
26 1989 Tea & Coffee Trade Journal article entitled
27 "Espresso: a jewel of flavor" by Sturdivant, pages
28 30-34. In France and Italy, where espresso coffee
29 has been popular for years, there are many skilled
30 espresso machine operators. The chances of
31 obtaining a high quality of espresso coffee from
32 such operators are above average. In other
33 countries where espresso coffee is growing in
34 popularity, there is a scarcity of skilled
35 operators and the resultant quality of espresso
36 coffee suffers. Thus there is a need for espresso
37 coffee extraction processes and machines that do

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39

1 not rely on operator skill to produce high quality
2 espresso coffee.

3
4 U.S. patents 4,136,202 and 4,806,375 by Favre
5 relate to sealed cartridges or capsules containing
6 a substance for making a beverage such as espresso
7 coffee. These containers include a filter as part
8 of the floor thereof. An outlet opening is created
9 by pressure induced failure of the capsule
10 exterior. In 4,136,202, this is obtained through
11 rupture of a C-shaped scoring in a lower baffle
12 whereas a plastic seam is caused to fail in
13 4,806,375.

14
15 In either case, the espresso coffee making function
16 is performed exactly as in the prior art once the
17 cartridge or capsule security is broken. This
18 means that an espresso machine operator using the
19 Favre type of containers is denied the opportunity
20 to control the compaction of the ground coffee.
21 Worse, the compaction of the coffee within the
22 containers is subject to disturbance in normal
23 handling prior to placement in a machine. In
24 addition, the operator can only use coffee supplied
25 in the containers, not any coffee.

26
27 It is desirable to eliminate the variability in
28 extraction quality based on extraction pressures
29 which is dependent upon operator experience and
30 skill.

31
32 SUMMARY OF THE INVENTION

33
34 In view of the foregoing, it is an object of this
35 invention to provide an improved espresso coffee
36 extraction process in which the extraction pressure

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1 is precisely regulated by the espresso machine and
2 is not a function of operator skill.

3
4 It is a further object of this invention to provide
5 an improved espresso coffee extraction process in
6 which the pressure for coffee extraction is kept
7 constant throughout the ground coffee beans
8 resulting in optimum extraction from all the ground
9 coffee beans.

10
11 It is a further object of this invention to provide
12 an improved espresso coffee extraction process in
13 which a relatively wide range of coffee bean grind
14 sizes is accommodated.

15
16 These and other objects of the invention are
17 accomplished in accordance with the principles of
18 the invention by use of an espresso coffee
19 extraction process in which the extraction pressure
20 necessary to produce high quality espresso coffee
21 is not dependent on the compaction of the ground
22 coffee beans by the operator. The pressure is
23 controlled by a pressure valve on the outflow of
24 the filter which holds the ground coffee beans.

25
26 As in the conventional espresso coffee extraction
27 process, the volume of ground coffee and the volume
28 of water forced through the ground coffee are
29 volumetrically measured. Unlike the conventional
30 process, however, the fineness of the coffee grind
31 used in the improved process can range from a fine
32 espresso grind to a coarser or finer coffee grind.
33 In addition, in the improved process, manual
34 compaction of the ground coffee beans is not
35 needed.

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1 A measured volume of water, either hot or cold, is
2 forced through the ground coffee beans as in a
3 conventional process. In the conventional process
4 the pressure required to extract the coffee from
5 the ground beans is created by the compacted coffee
6 grinds which restricts the flow of water through
7 the coffee grinds until the water pressure is high
8 enough to penetrate the barrier created by the
9 compacted ground coffee. The pressure varies
10 throughout the ground coffee beans starting at the
11 highest level on the side of the water inflow to
12 the ground coffee and decreasing to zero pressure
13 at the water outflow point.
14

15 In the improved process, however, the requisite
16 pressure results from a mechanical valve on the
17 outflow of the filter. A measured volume of water
18 is introduced into the filter which holds the
19 ground coffee beans. When the pressure reaches the
20 optimum pressure for extraction, the valve
21 regulator begins to open allowing the water to pass
22 through the ground coffee beans. The pressure
23 throughout all the ground coffee beans is the same
24 - there is no pressure gradient. Because the
25 optimum extraction pressure extends to all of the
26 ground coffee beans, less ground coffee beans are
27 required to make espresso coffee than conventional
28 methods.
29

30 Thus the invention employs a valve apparatus
31 associated with a brewing chamber assembly
32 including a regulator, downstream of the ground
33 coffee, which precisely controls extraction
34 pressure regardless of coffee grind size or coffee
35 compaction, or incoming water supply pressure. The
36 operator simply places ground coffee in the brewing
37 chamber and attaches the regulator assembly to the
38
39

1 espresso machine. Water is introduced into the
2 brewing chamber as in prior espresso machines, but
3 rather than relying on the compaction of the ground
4 coffee to create the pressure barrier, the valve on
5 the downstream side of the brewing chamber creates
6 the pressure barrier and only opens to allow coffee
7 extraction once a predetermined pressure is
8 reached. Thus, the ideal pressure differential is
9 maintained between the inlet and outlet of the
10 brewing chamber.

11
12 The process for extracting espresso coffee from
13 ground coffee beans in accordance with this
14 invention starts with the step of placing ground
15 coffee beans in a filter basket. Water is then
16 moved through the ground coffee beans in the filter
17 basket. Finally, the pressure of the water is
18 controlled so the water surrounding the ground
19 coffee beans between the water inlet and the
20 downstream outlet for the water after the water has
21 passed through the ground coffee beans is such that
22 the pressure differential thereacross remains
23 constant regardless of variations in the inlet and
24 outlet pressures.

25
26 Apparatus of this invention for extracting espresso
27 coffee from ground coffee beans includes a source
28 of pressurized liquid along with a pressure
29 regulating valve. The valve inlet receives the
30 liquid and an outlet discharges it. The valve
31 remains closed to liquid flow therethrough until a
32 predetermined pressure is reached between the inlet
33 and outlet and thereafter the valve begins to open
34 to allow liquid to flow therethrough while
35 maintaining a constant pressure between the inlet
36 and outlet. A container receives the ground coffee
37 beans and includes a filter element for
38
39

1 establishing a closed path for flow of the liquid
2 from the source through the beans and filter into
3 the valve inlet.
4

5 The present invention is an apparatus for
6 cooperatively interfacing with the source of
7 pressurized fluid for an espresso coffee machine.
8 It employs a chamber for receiving ground coffee
9 beans and including an inlet for receiving
10 pressurized fluid from the espresso machine source
11 and an outlet for allowing fluid flow through the
12 chamber. A regulator valve has an input (coupled
13 to the chamber outlet) and an output. This
14 regulator valve responds to fluidic pressure at its
15 input by blocking fluid passage between that input
16 and its output until a predetermined pressure is
17 reached. Thereafter it allows fluid flow between
18 its input and output with a flow magnitude adjusted
19 for maintaining constant pressure of the fluid at
20 its input.
21

22 The brewing chamber filter prevents the ground
23 coffee beans from passing through the chamber
24 outlet with the fluid. In one configuration, the
25 regulator valve includes a piston element movably
26 mounted between a fluid flow blocking position
27 relative to the filter output and positions where
28 the amount of fluid flow from the filter is
29 proportioned to the distance of the piston element
30 from the filter.
31

32 The piston element is normally biased towards the
33 filter with a force requiring pressure on the
34 piston element from the fluid in the chamber at a
35 level equal to or greater than the aforementioned
36 predetermined pressure. The biasing of the piston
37 allows fluid flow from the chamber outlet in
38
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-9-

1 quantities proportioned to the amount of flow
2 supplied so long as it is supplied while the
3 pressure on the chamber fluid exceeds the
4 predetermined pressure.

5
6 The regulator valve can employ a plate having at
7 least one fluid passageway therethrough mounted in
8 intervening relation to the piston element and
9 filter. By use of a central opening through the
10 piston element, the piston element can move so as
11 to block its central opening by engaging a portion
12 of the plate displaced from the fluid passageways
13 when the pressure on the chamber fluid is less than
14 the predetermined pressure.

15
16 An advantageous feature of the present invention is
17 that it can utilize a housing for retaining the
18 filter and regulator valve as a unitary assembly.
19 This permits manual attachment and removal of the
20 chamber with respect to an espresso coffee machine
21 with the chamber inlet in fluidic communication
22 with the espresso machine pressurized fluid source.

23
24 Those having normal skill in the art will recognize
25 the foregoing and other objects, features,
26 advantages and applications of the present
27 invention from the following more detailed
28 description of the preferred embodiments as
29 illustrated in the accompanying drawings.

30

31 BRIEF DESCRIPTION OF THE DRAWINGS

32

33 FIG. 1 is an illustration of an espresso machine
34 improved in accordance with this invention.

35

36 FIG. 2 is a flow chart of the improved espresso
37 coffee extraction process.

38

39

1 FIG. 3 is a schematic diagram of the liquid flow
2 within an espresso machine in accordance with this
3 invention.

4

5 FIG. 4 is an exploded perspective view of an
6 embodiment incorporating a brewing chamber and
7 regulator assembly in a common housing.

8

9 FIG. 5 is a sectioned view of the filter and
10 regulator assembly of FIG. 4 with the valve in the
11 closed position.

12

13 FIG. 6 is a sectioned view of the FIG. 4 filter and
14 regulator assembly with the valve in the fully open
15 position.

16

17 FIG. 7 is an isometric view of another embodiment
18 of the present invention.

19

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

21

22 Referring now to the drawings, there is shown in
23 FIG. 1 a partial view of an espresso coffee machine
24 10 showing an assembly 12 which includes a ground
25 coffee bean filter 14, a pressure regulation valve
26 mechanism 16, and a handle 15 for manually removing
27 and attaching assembly 12 to machine 10. The
28 final espresso coffee product extracted from
29 assembly 12 is dispensed from outflow spout 18 for
30 collection in cups 20. FIG. 2 is a flow chart of
31 the steps in the process of extracting espresso
32 coffee which includes the improved process. The
33 following discussion references both figures.

34

35 At step 100 coffee beans are ground by any suitable
36 contemporary device or technique. The grind
37 accommodated in the improved process includes a

38

39

1 range from grind sizes finer than conventional
2 espresso coffee grinds to the grind sizes coarser
3 than conventional espresso coffee grinds. At step
4 101 a measured volume of the ground coffee beans is
5 placed in the filter 14 of the assembly 12. Unlike
6 conventional espresso extraction processes, the
7 ground coffee does not require compaction in the
8 filter 14.

9
10 At step 102 a measured quantity of water is moved
11 through the ground coffee beans in the filter 14.
12 Water pressure builds within the filter until a
13 predetermined pressure level is reached. The
14 particular pressure level is based on the optimum
15 extraction pressure for a given volume and
16 temperature of water.

17
18 When the optimum pressure is reached (eg.: in the
19 range of 7 to 12 bars), regulator valve mechanism
20 16 on the outflow of the filter opens (step 103A)
21 allowing the extracted espresso coffee to begin
22 flowing from the filter 14. As indicated by step
23 103B, the regulator valve 16 thereafter controls
24 the amount of flow from the filter 14 so that a
25 relatively constant pressure is maintained within
26 the brewing chamber and across the filter 14.
27 There are a variety of commercially available
28 pressure regulating valves available which are
29 suitable for valve 16, such as a Speedaire Model
30 No. 2X947A, Dayton Electric Manufacturing Co.,
31 Chicago, Ill. 66648. The machine outflow spout 18
32 is downstream of the ground coffee beans and
33 regulator valve 16. At step 104 the extracted
34 espresso coffee is distributed for collection in
35 either or both of cups 20.

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1 In the improved process of extraction pursuant to
2 this invention, extraction pressure is controlled
3 by the valve mechanism 16 and not by a variable
4 such as the degree of compaction of the ground
5 coffee beans as in a conventional process.
6 The brewing chamber and regulator assembly 12 as
7 shown in FIG. 1 has an exterior appearance which is
8 superficially similar to the filter structure of a
9 traditional espresso machine utilizing a handle and
10 housing.

11
12 FIG. 3 schematically depicts the fluid flow pattern
13 through an espresso coffee machine modified in
14 accordance with the present invention. A boiler or
15 other source 25 introduces heated water under
16 pressure to brewing chamber 28 via inlet 26. The
17 water temperature for hot espresso extraction is
18 typically 86°C to 92°C which is comparable to the
19 water temperature often used in prior art espresso
20 machines. The ground coffee 30 is placed in the
21 lower basket of chamber 28. A filter (not shown in
22 FIG. 3) associated with the floor 32 of chamber 28
23 separates coffee 30 from outlet 33. The filter
24 generally has a porosity equivalent to contemporary
25 espresso machine filters.

26
27 Regulator valve 35 is coupled in intervening
28 relation between outlet 33 of chamber 28 and
29 exhaust pipe 36. Whenever the pressure inside
30 chamber 28 and thus at chamber outlet 33 exceeds a
31 predetermined level, regulator valve 35 opens and
32 allows the fluid flow from outlet 33 into pipe 36
33 to commence. Valve 35 thereafter adjusts the
34 volume of fluid flow so as to maintain the pressure
35 at outlet 33 and thus within chamber 28 relatively
36 constant regardless of changes in the flow through
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1 chamber 28 for whatever reason. Ultimately the
2 extracted espresso coffee is collected in cup 38.

3
4 An embodiment of a preferred form of a filter and
5 regulator valve assembly 40 in accordance with this
6 invention is shown in FIG. 4 with its operation
7 illustrated in FIGS. 5 and 6. A flat metal
8 strainer screen 42 is positioned in the bottom
9 portion of the brewing chamber 44 within the
10 housing 41 and is held in place by a flat screen
11 lock ring 45. Ground coffee beans placed in the
12 brewing chamber 44, sit on top of the flat metal
13 strainer screen 42 and the screen prevents ground
14 coffee from entering the valve mechanism 48.

15
16 A valve ring 50 is positioned on the bottom side of
17 the flat metal strainer screen 42. This part is
18 held to the housing 41 by means of three screws
19 such as screw 51. It has several flow holes 52
20 (shown as 52A and 52B in FIGS. 5 and 6) through
21 which liquid coffee flows after extraction. The
22 valve ring 50 prevents deflection of the flat metal
23 strainer screen 42.

24
25 A pressure gasket 54 is located between the top of
26 the head 58 of piston 55 and the bottom side of the
27 valve ring 50. Gasket 54 seals the valve ring 50
28 flow holes 52 when the piston 55 is pressed against
29 the bottom of the valve ring 50. A piston retainer
30 ring 56 encircles the head 58 of the piston 55 and
31 provides a guide in which piston 55 moves.

32
33 Round spring washers 61-63 shown in the bell-type
34 configuration sit atop flat washer 64. Washers
35 61-64 surround and locate piston 55 within annular
36 recess 65 (note FIG. 5) which forms a channel to
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1 seat washers 61-64 in housing 41. Springs 61-63
2 force the top surface of the head 58 of piston 55
3 against the bottom side of the pressure gasket 54.
4 A force is exerted onto the top of piston head 58
5 when water under pressure is introduced into the
6 brewing chamber 44. The spring washers 61-63
7 compress allowing displacement of piston 55 in a
8 downward direction.

9
10 The piston head 58 has a greater circumference than
11 the stem 59 which has a hole 60 through its center
12 and extending along its length, through which
13 liquid can flow. That is, flow channel 60 is the
14 channel through the piston which supports coaxial
15 liquid flow once the piston is displaced in a
16 downward direction.

17
18 Ground coffee is placed in brewing chamber 44 on
19 top of the flat metal strainer screen 42, but the
20 user need not compact the coffee grounds. The
21 regulator assembly 40 is attached to the espresso
22 machine. Water, under pressure, is introduced into
23 the brewing chamber 44. The valve mechanism 48 of
24 the invention is initially in the shut position as
25 is best seen in FIG. 5. Pressure builds within the
26 brewing chamber 44 until a predetermined pressure
27 is reached. For the extraction of espresso coffee
28 the ideal pressure is approximately 125 psi.

29
30 When the predetermined pressure is reached, the
31 spring washers 61-63 begin to compress allowing the
32 piston 55 to displace in a downward direction. By
33 using constant force springs, pressure will remain
34 constant independent of flow. The pressure gasket
35 54 effectively transfers the pressure present on
36 the fluid in outlet ports 52 to the upper face of
37 head 58 of piston 55. Piston head 58 moves

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39

1 downwardly to increase liquid flow from chamber 44
2 thereby reducing the pressure in chamber 44 until
3 equilibrium is reached with the force of springs
4 61-63. Further, gasket 54 deflects with movement
5 of the piston head 58 allowing liquid to flow
6 through the outlet formed by valve ring flow holes
7 52 into coaxial channel 60.

8
9 The liquid continues to flow through flow channel
10 60 which extends coaxially through the interior of
11 piston 55 and exits out the bottom of piston 55.
12 Valve 48 thereafter functions as a regulator valve.
13 That is, the quantity of flow through valve 48 is a
14 function of the amount of compression of spring
15 washers 61-63 which, in turn, is a function of the
16 pressure on the heated water present in brewing
17 chamber 44.

18
19 When water flow to the brewing chamber 44 ceases,
20 the pressure within chamber 44 decreases eventually
21 dropping below the predetermined valve pressure.
22 At this point the spring washers 61-63 decompress
23 forcing the piston 55 and pressure gasket 54
24 against the bottom side of the valve ring 50. This
25 action seals the valve ring flow holes 52 and stops
26 the flow of liquid by returning the structure to
27 the FIG. 5 configuration.

28
29 The predetermined pressure under which the valve 48
30 opens is based on the ideal extraction pressure
31 needed for brewing a particular kind of coffee.
32 Since the valve 48 only remains open when this
33 pressure is maintained, extraction or brewing only
34 occurs when the proper pressure exists within the
35 brewing chamber 44.

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-16-

1 Note that housing 41 in FIG. 4 has a handle 43
2 attached thereto and camming ears 46 and 47 on
3 either side of its upper exterior surface. This
4 accommodates attachment to mating structure on the
5 espresso machine with a tight seal by inserting the
6 camming ears into a slot and turning the assembly
7 horizontally as is conventional. The threaded
8 collar 66 (note FIGS. 5 and 6) is arranged to
9 secure an appropriate output pipe for delivering
10 the fluid to receiving cups, containers, or the
11 like.

12
13 FIG. 7 illustrates another embodiment of this
14 invention employing a filter and regulator assembly
15 70. Housing 71 includes a brewing chamber 72 with
16 a filter screen associated with its bottom outlet
17 73. In this configuration, the regulator valve 75
18 is attached to outlet 73. Commercially available
19 valves such as the Speedaire Model No. 2X947A from
20 Electric Manufacturing of Chicago, Illinois are
21 suitable for valve 75. The outlet of valve 75 is
22 attachable to a spout for dispensing to a
23 receptacle. Handle 76 and camming ears such as 78
24 accommodate sealed attachment of assembly 70 to an
25 espresso machine similar to that described above
26 for FIG. 4.

27
28 While the exemplary preferred embodiments of the
29 present invention are described herein with
30 particularity, those having normal skill in the art
31 will recognize various changes, modifications,
32 additions and applications other than those
33 specifically mentioned herein without departing
34 from the spirit of this invention.

35
36 What is claimed is:

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CLAIMS

1. An improved process for extracting espresso coffee from ground coffee beans comprising the steps of:
 - placing ground coffee beans in a container having an inlet and an outlet;
 - moving water from the container inlet through said ground coffee beans and into the container outlet; and
 - controlling the pressure of said water surrounding said ground coffee beans between the container water inlet and the downstream water outlet so that the pressure differential across the ground coffee beans remains constant regardless of variations in the inlet and outlet pressures.
2. Apparatus for extracting espresso coffee from ground coffee beans comprising:
 - a source of pressurized liquid;
 - a pressure regulating valve having an inlet for receiving said liquid and an outlet for discharging said liquid, said valve remaining closed to liquid flow therethrough until a predetermined pressure is reached between said inlet and said outlet and thereafter opening to allow flow of said liquid therethrough for maintaining a constant pressure between said inlet and said outlet; and
 - means for receiving a container having said ground coffee beans and a filter for establishing a closed path for flow of said liquid from said source through said beans and said filter into said valve outlet.

1 3. Apparatus for cooperatively interfacing with
2 the source of pressurized fluid for an espresso
3 coffee machine comprising:

4 means having a chamber for receiving ground
5 coffee beans and including an inlet for receiving
6 pressurized fluid from the espresso machine source
7 and an outlet for allowing fluid flow from said
8 chamber, and

9 regulator valve means having an input coupled to
10 said chamber means outlet and an output, said
11 regulator valve means responding to fluidic
12 pressure at said valve input by blocking fluid
13 passage between said input and said output until a
14 predetermined pressure is reached and thereafter
15 allowing fluid flow between said input and said
16 output with a flow magnitude for maintaining
17 constant pressure of the fluid at said input.

18

19

20 4. Apparatus in accordance with claim 3 wherein
21 said chamber means includes filter means for
22 preventing the ground coffee beans from passing
23 through said chamber outlet with the fluid.

24

25

26 5. Apparatus in accordance with claim 4 wherein
27 said regulator valve means includes a piston
28 element movably mounted between a fluid flow
29 blocking position relative to said chamber outlet
30 and positions where the amount of fluid flow from
31 said chamber outlet is proportioned to the distance
32 of said piston element from said chamber outlet,
33 and means biasing said piston element towards said
34 chamber outlet with a force requiring pressure on
35 said piston element from the fluid in said chamber
36 at a level equal to or greater than said
37 predetermined pressure.

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1 6. Apparatus in accordance with claim 5 wherein
2 said biasing means allows fluid flow from said
3 chamber outlet in quantities proportioned to the
4 amount by which the pressure of said chamber fluid
5 exceeds said predetermined pressure.

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7
8 7. Apparatus in accordance with claim 6 which
9 includes a plate having at least one fluid
10 passageway therethrough and mounted in intervening
11 relation to said piston element and said filter
12 means, said piston element having a central opening
13 therethrough, said piston element being movably
14 mounted for blocking said piston element central
15 opening by engaging a portion of said plate
16 displaced from said fluid passageway when the
17 pressure on said chamber fluid is less than said
18 predetermined pressure.

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21 8. Apparatus in accordance with claim 3 which
22 includes housing means for manually attaching and
23 removing said chamber to the espresso coffee
24 machine with said chamber inlet in fluidic
25 communication with the espresso machine pressurized
26 fluid source.

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1 9. Apparatus in accordance with claim 3 which
2 includes a housing retaining said chamber means and
3 said regulating valve means in operative relation
4 to one another as a unit, said housing including
5 means for removably attaching said unit to the
6 espresso coffee machine with said chamber inlet in
7 fluidic communication with the source of
8 pressurized fluid.

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11 10. Apparatus in accordance with claim 9 wherein
12 said housing includes means for manually attaching
13 and removing said unit from the espresso coffee
14 machine.

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1 11. Apparatus for regulating the flow of fluid
2 through the chamber of an espresso coffee machine
3 where the chamber includes an arrangement for
4 retaining ground coffee beans therein with a filter
5 for allowing fluid to pass to the chamber outlet
6 while blocking passage of the ground coffee beans
7 comprising:

8 input means coupled to the chamber outlet, and
9 means responsive to the pressure of the fluid at
10 said input means for blocking fluid passage
11 therethrough until the pressure of said input means
12 fluid reaches a predetermined magnitude and for
13 responding to pressure of said input means fluid
14 greater than said predetermined magnitude by
15 allowing fluid flow therethrough of a magnitude for
16 maintaining the fluid pressure at said input means
17 substantially constant.

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20 12. Apparatus in accordance with claim 11 wherein
21 said pressure responsive means includes

22 a plate having at least one solid portion and a
23 plurality of passageways therethrough for
24 interfacing with the chamber filter,

25 a piston having a fluid flow channel therethrough
26 from an opening in the head of said piston,

27 a housing mounting said piston for movement
28 between a position wherein said piston head opening
29 is in closing abutment with said plate solid
30 portion and a position wherein said piston head
31 opening is displaced from said plate for allowing
32 fluid to flow from said plate passageways into said
33 piston fluid flow channel, and

34 means biasing said piston towards said plate
35 solid portion with a force corresponding to said
36 predetermined pressure magnitude.

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1 13. Apparatus in accordance with claim 12 wherein
2 said biasing means is a spring positioned to
3 cooperate between said housing and said piston head
4 for forcing said piston head against said plate.

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7 14. Apparatus in accordance with claim 13 which
8 includes a flexible gasket having an opening
9 therethrough with said housing including means
10 mounting said gasket between said plate and said
11 piston head with said gasket opening in alignment
12 with said piston head opening for sealing said
13 plate passageways while transmitting the fluid
14 pressure on said plate from the chamber to the face
15 of said piston.

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1 15. Apparatus for extracting espresso coffee from
2 ground coffee beans comprising
3 means having a chamber for receiving the ground
4 coffee beans and having an inlet and an outlet for
5 accommodating fluid flow through said chamber,
6 means for introducing pressurized fluid in said
7 chamber through said inlet thereof, and
8 regulator valve means coupled to said chamber
9 outlet for allowing fluid flow from said chamber
10 only after the pressure of said pressurized fluid
11 equals a predetermined pressure and for thereafter
12 controlling the amount of flow of said fluid
13 through said valve means so as to maintain a
14 substantially constant pressure on said fluid
15 between said chamber inlet and outlet.

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18 16. Apparatus in accordance with claim 15 for use
19 with an espresso coffee machine which has a source
20 of pressurized fluid, said apparatus further
21 including housing means for retaining said chamber
22 means and said regulator valve means in fluidic
23 communication relative to one another, said housing
24 means further including means for manually
25 attaching said chamber means inlet in sealed
26 relation to the pressurized fluid source.

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29 17. Apparatus in accordance with claim 16 wherein
30 said housing means retains said chamber means and
31 said regulator valve means in a common shell.

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34 18. Apparatus in accordance with claim 16 wherein
35 said housing means includes means for removably
36 retaining said regulator valve relative to said
37 chamber means.

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AMENDED CLAIMS

[received by the International Bureau on 3 September 1991 (03.09.91)
original claims 1-4,9,11-18 amended; other claims unchanged (6 pages)]

1. An improved process for extracting espresso coffee from ground coffee beans comprising the steps of:

placing ground coffee beans in a container having an inlet and an outlet;

providing a pressurized source of water,

sensing the water pressure of said source of water,

moving water from the container inlet through said ground coffee beans and into the container outlet only when the water pressure of said source of water reaches a given magnitude; and

thereafter controlling the pressure of said water surrounding said ground coffee beans between the container water inlet and the downstream water outlet so that the water pressure differential across the ground coffee beans remains constant regardless of variations in the inlet and outlet pressures as water moves through said ground coffee beans.

2. Apparatus for extracting espresso coffee from ground coffee beans comprising:

a source of pressurized liquid;

a normally closed pressure regulating valve having an inlet for receiving said liquid and an outlet for discharging said liquid, said valve remaining closed to liquid flow therethrough until a predetermined pressure is reached between said inlet and said outlet, said valve thereafter opening to allow flow of said liquid from said inlet to said outlet, and said valve thereafter maintaining a constant pressure between said inlet and said outlet; and

means for receiving a container having said ground coffee beans and a filter for establishing a closed path for flow of said liquid from said source through said beans and said filter into said valve inlet when said valve is open.

3. Apparatus for cooperatively interfacing with the source of pressurized fluid for an espresso coffee machine comprising:

means having a chamber for receiving ground coffee beans and including an inlet for receiving pressurized fluid from the espresso machine source and an outlet for allowing fluid flow from said chamber, and

normally closed regulator valve means having an input coupled to said chamber outlet and an output, said regulator valve means responding to fluidic pressure at said valve input by blocking fluid passage between said valve input and said valve output until a predetermined pressure is reached and thereafter allowing fluid flow between said valve input and said valve output with a flow magnitude for maintaining constant pressure of the fluid at said valve input.

4. Apparatus in accordance with claim 3 wherein said chamber includes filter means for preventing the ground coffee beans from passing through said chamber outlet with said fluid flow.

5. Apparatus in accordance with claim 4 wherein said regulator valve means includes a piston element movably mounted between a fluid flow blocking position relative to said chamber outlet and positions where the amount of fluid flow from said chamber outlet is proportioned to the distance of said piston element from said chamber outlet, and means biasing said piston element towards said chamber outlet with a force requiring pressure on said piston element from the fluid in said chamber at a level equal to or greater than said predetermined pressure.

9. Apparatus in accordance with claim 3 which includes a housing retaining said chamber and said regulator valve means in operative relation to one another as a unit, said housing including means for removably attaching said unit to the espresso coffee machine with said chamber inlet in fluidic communication with the source of pressurized fluid.

10. Apparatus in accordance with claim 9 wherein said housing includes means for manually attaching and removing said unit from the espresso coffee machine.

11. Apparatus for regulating the flow of fluid through the chamber of an espresso coffee machine, said chamber including a chamber inlet, a chamber outlet, and an arrangement for retaining ground coffee beans therein with a filter for allowing pressurized fluid to pass to the chamber outlet while blocking passage of the ground coffee beans comprising:

fluid input means coupled to the chamber outlet, and normally closed pressure responsive means responsive to the pressure of the fluid at said input means for blocking fluid passage therethrough until the fluid pressure at said input means reaches a predetermined magnitude and for responding to fluid pressure at said input means greater than said predetermined magnitude by allowing fluid flow therethrough of a magnitude for thereafter maintaining the fluid pressure at said input means substantially constant.

12. Apparatus in accordance with claim 11 wherein said pressure responsive means includes

a plate having at least one solid portion and a plurality of passageways therethrough for interfacing with said filter,

a piston having a head, an opening in said head, and a fluid flow channel through said piston from said opening in said head,

a housing mounting said piston for movement between a first position wherein said piston head opening is closed by abutment with said plate solid portion and a second position wherein said piston head opening is open and displaced from said plate solid portion for allowing fluid to flow from said plate passageways into said piston fluid flow channel, and

means biasing said piston towards said plate solid portion with a force corresponding to said predetermined pressure magnitude.

13. Apparatus in accordance with claim 12 wherein said biasing means is a spring positioned to cooperate between said housing and said piston head for forcing said piston head against said plate solid portion.

14. Apparatus in accordance with claim 13 which includes a flexible gasket having an opening therethrough with said housing including means mounting said gasket between said plate and said piston head with said gasket opening in alignment with said piston head opening for sealing said plate passageways while transmitting the fluid pressure on said plate from the chamber to said piston head.

15. Apparatus for extracting espresso coffee from ground coffee beans comprising

means having a chamber for receiving the ground coffee beans and having an inlet and an outlet for accommodating fluid flow through said chamber,

means for introducing pressurized fluid in said chamber through said inlet thereof, and

normally closed regulator valve means coupled to said chamber outlet for allowing fluid flow from said chamber only after the pressure of said pressurized fluid equals a predetermined pressure and for thereafter controlling the amount of flow of said fluid through said regulator valve means so as to maintain a substantially constant pressure on said fluid between said chamber inlet and outlet.

16. Apparatus in accordance with claim 15 for use with an espresso coffee machine which has a source of pressurized fluid, said apparatus further including housing means for retaining said chamber and said regulator valve means in fluidic communication relative to one another, said housing means further including means for manually attaching said chamber inlet in sealed relation to the pressurized fluid source.

17. Apparatus in accordance with claim 16 wherein said housing means retains said chamber and said regulator valve means in a common shell.

18. Apparatus in accordance with claim 16 wherein said housing means includes means for removably retaining said regulator valve relative to said chamber.

STATEMENT UNDER ARTICLE 19

The present invention relates to an improved method and apparatus for extracting espresso coffee from ground coffee beans wherein a source of pressurized liquid is allowed to flow through the coffee beans under the control of a normally closed pressure regulating valve, such that the valve remains closed to liquid flow until a predetermined pressure is reached. The valve then opens, and thereafter liquid flows through the ground coffee beans, as the valve maintains a constant pressure across the ground coffee beans.

Constructional details of the normally closed pressure regulating valve are also claimed.

USP 4,882,982 teaches a percolator holding pan for an espresso machine wherein water flow through the coffee grounds is controlled by a continuously open, pressure responsive, constant flow device.

Applicant's method and apparatus prevents the flow of water through the coffee grounds until the control-point-pressure of a normally closed, pressure regulating valve is reached. Thereafter, water flows through the coffee grounds, while a constant pressure is maintained across the coffee grounds due to operation of the now-open pressure regulating valve.

In USP 4,882,982, a water-flow path always exists through the coffee grounds, and a flow regulator device operates to maintain the rate of water flow constant.

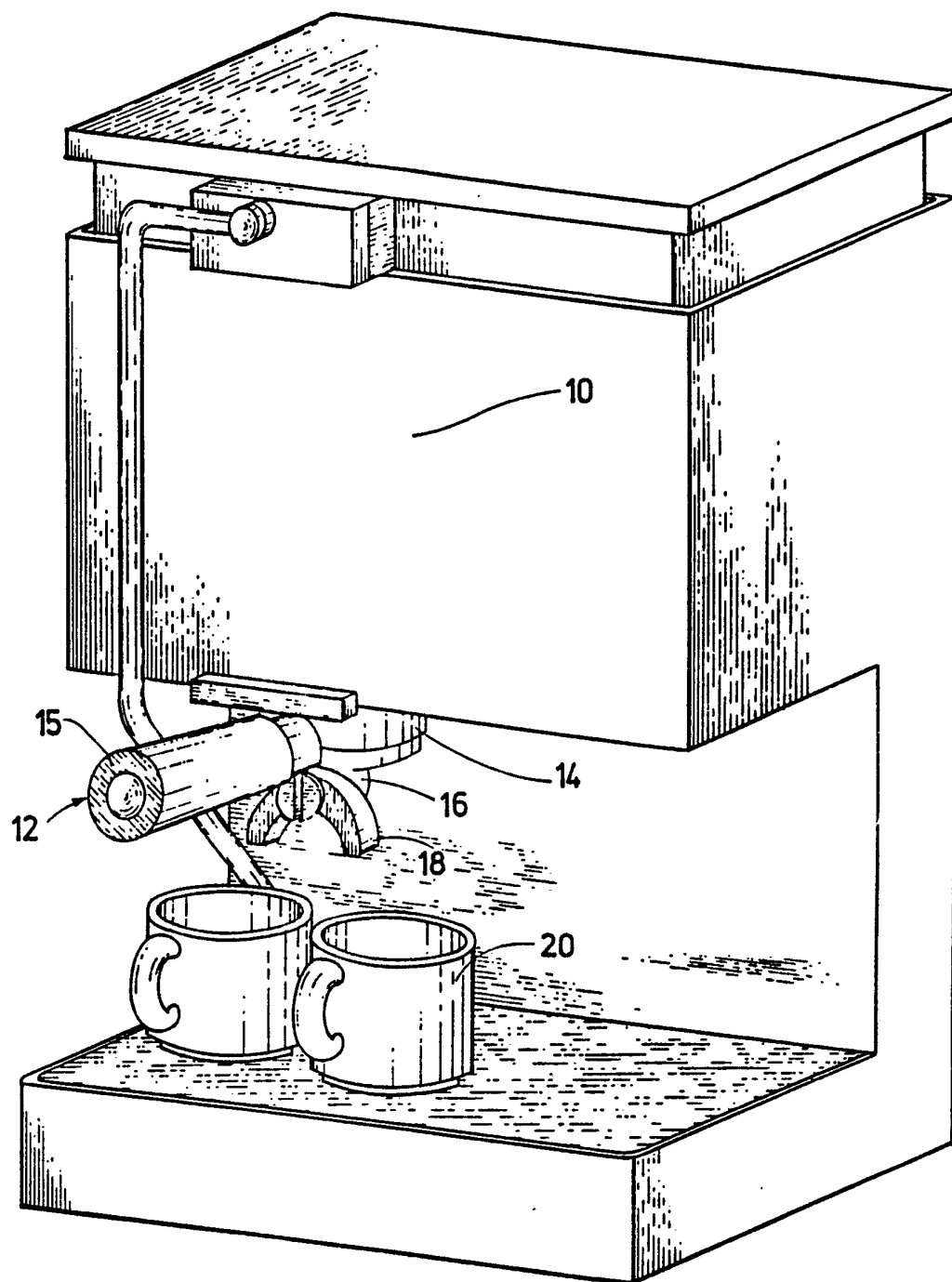


FIG. I

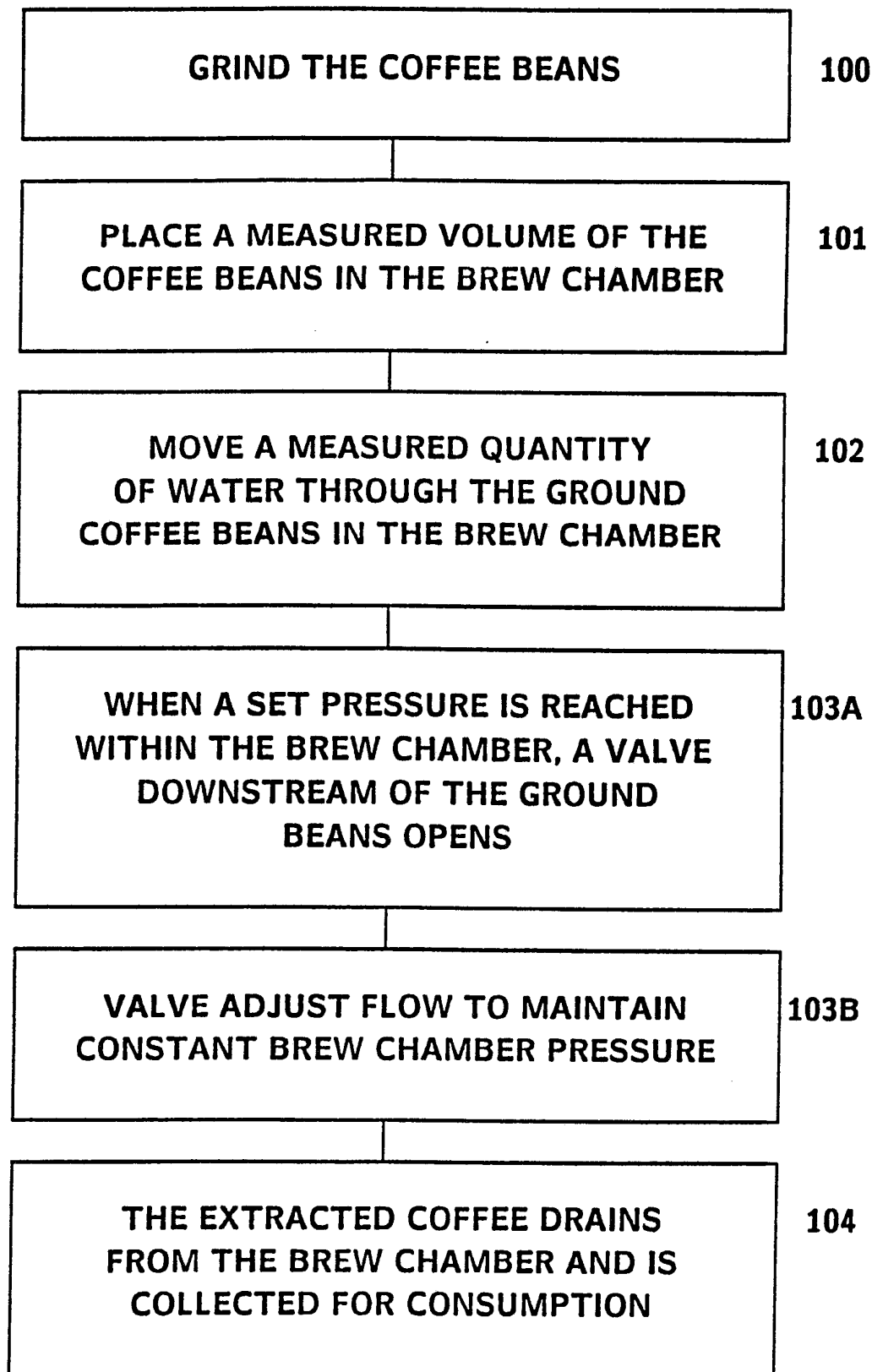


FIG. 2

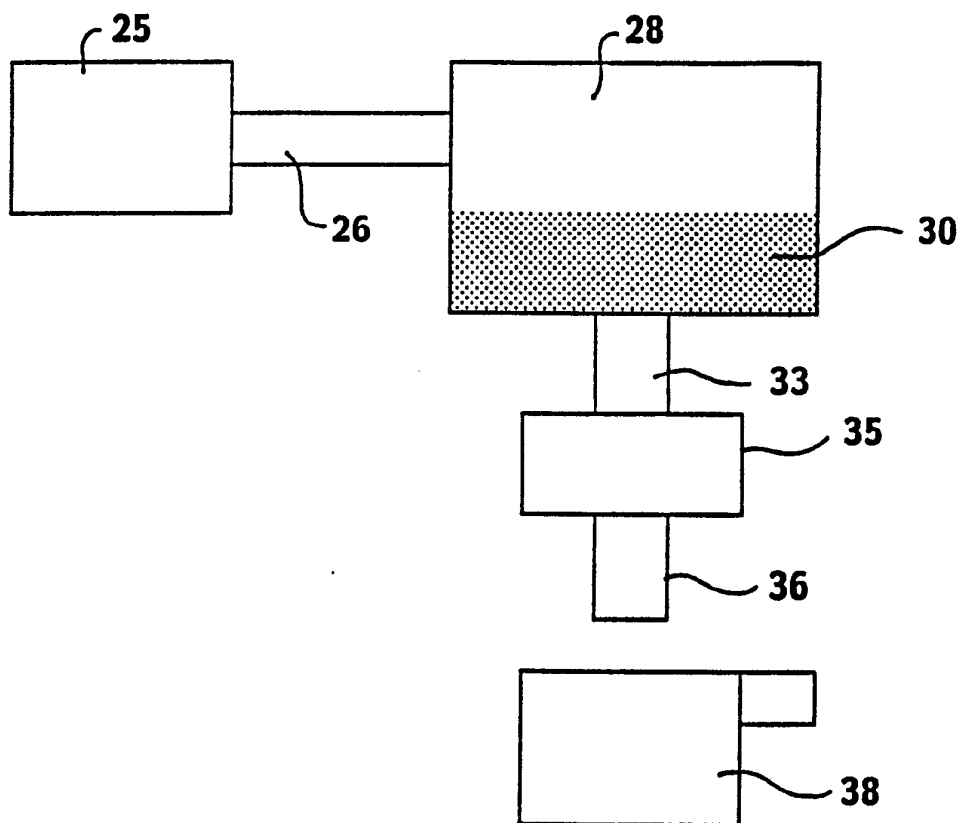
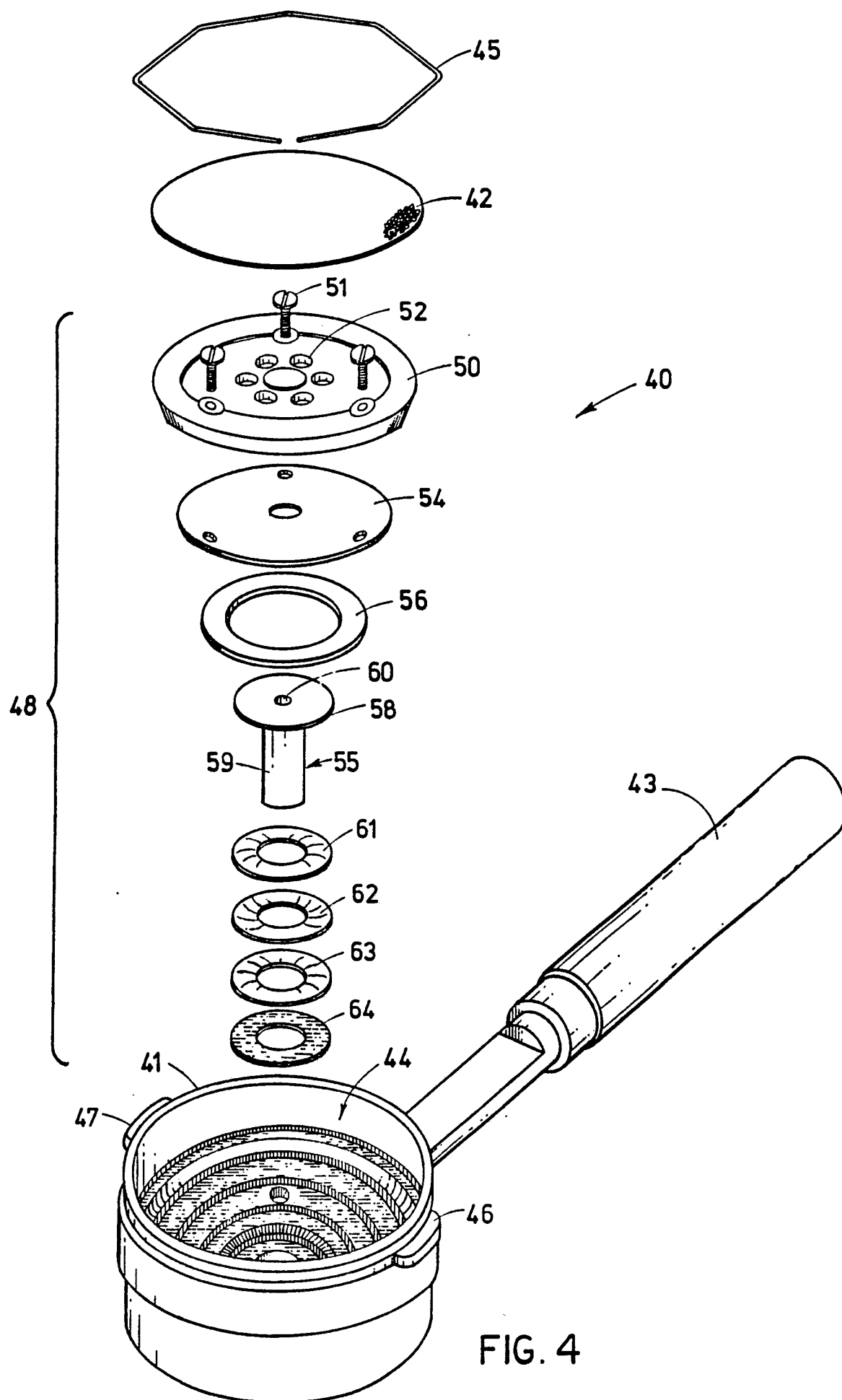
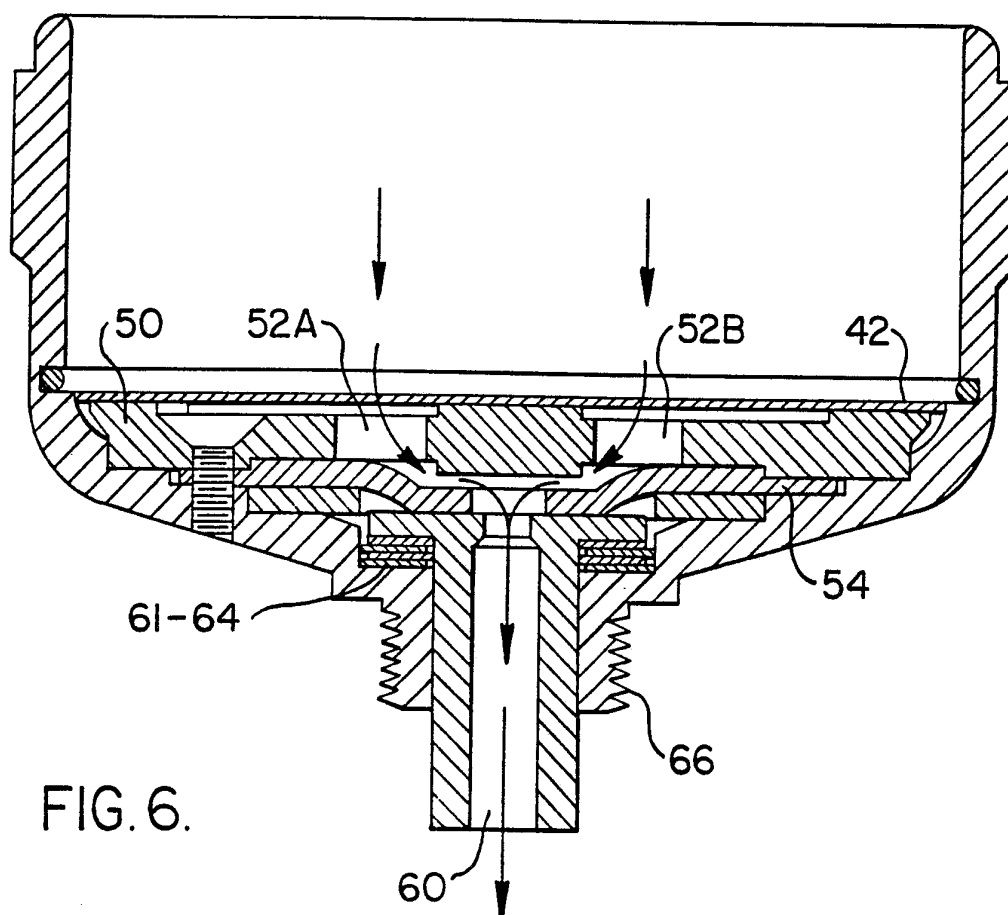
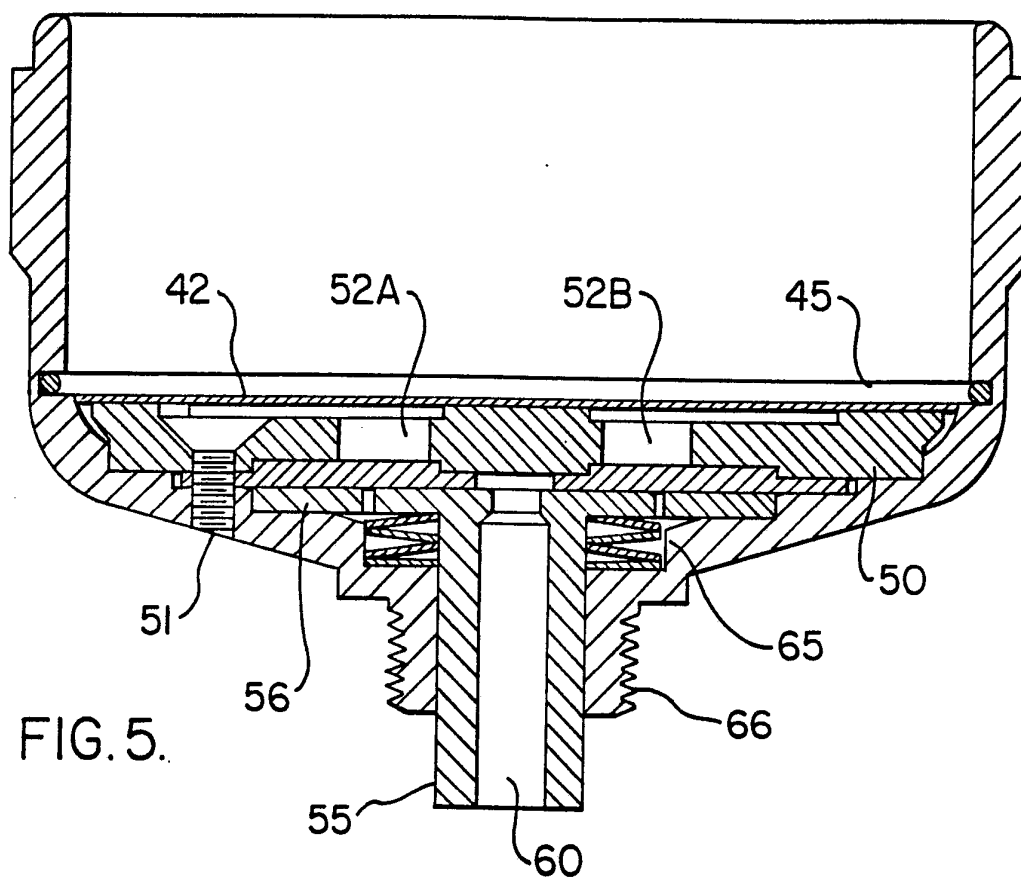


FIG. 3



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SUBSTITUTE SHEET

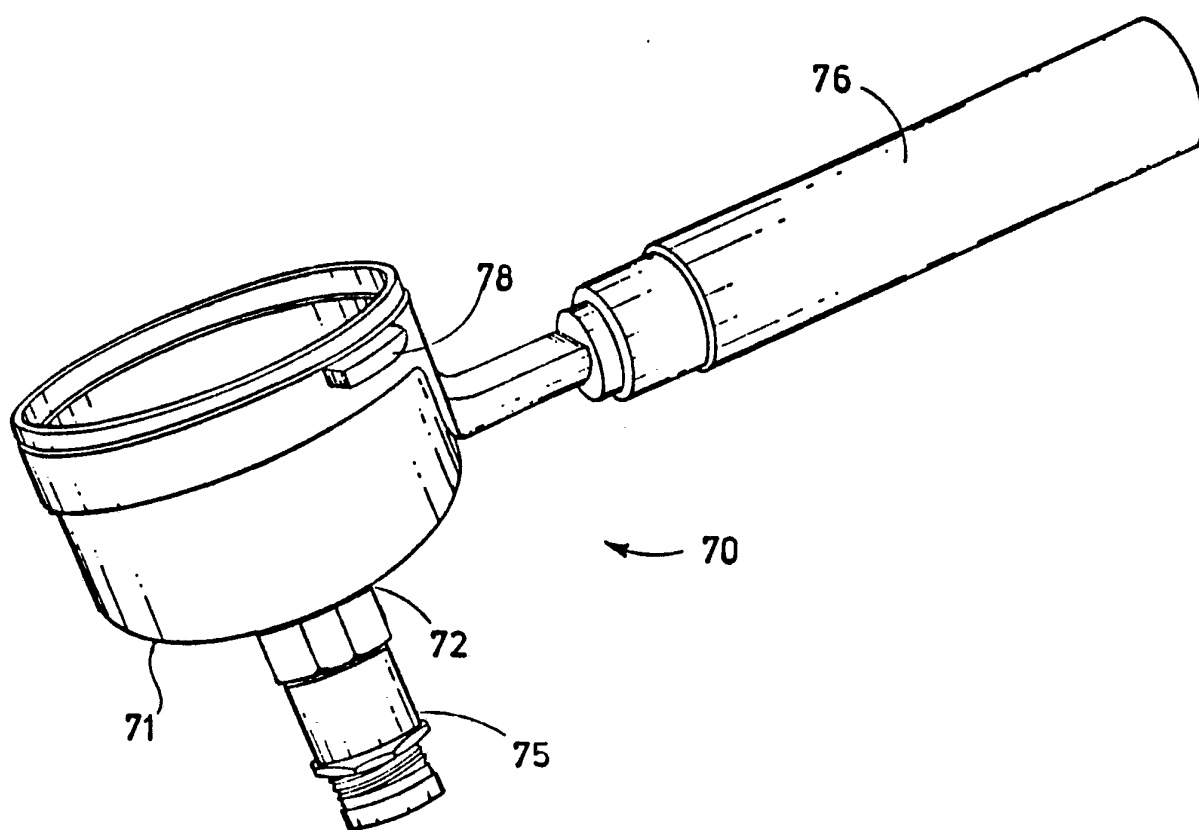


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/03142

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC (5) A47J 31/34		
U.S. CL 99/300		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
	99/279, 295, 299, 300, 301, 302R, 302F, 304, 305, 306, 307, 280,	
U.S.	282, 283, 293 426/433	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 4,882, 982 (Muttoni) 28, November 1989	1-4,8-11,15-18
A	US, A, 4,667,587 (Wunder) 26, May 1987	
A	US, A, 4, 843,955 (Henn) 04, July 1989	
* Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
11 JULY 1991	30 JUL 1991	
International Searching Authority	Signature of Authorized Officer	
ISA/US	ROBERT W. JENKINS	