

The present invention relates to a coffee machine, in particular an espresso coffee machine, as is described in the preamble of Patent Claim 1 and as is disclosed in the document EP-A-237399.

5 Such coffee machines have been known for some time and, although they are sold under the designation "espresso machines", are used for brewing up espresso coffee and for brewing up water for "café-crème". Fully
10 automatic coffee machines of the generic type generally have a piston motor which drives a piston for compacting the coffee powder located in the infusion chamber, with the result that, when the hot water runs through the compacted coffee powder (brews up), an aromatic coffee
15 beverage is obtained which has the taste which is desired by the customer as well as the famous "froth".

 Since the piston has to move in two directions, in the direction for compacting the coffee powder on the one hand and in the opposite direction on the other hand, in order to be able to eject the used coffee powder and
20 to introduce the fresh coffee powder, use is made of a high-outlay mechanism. Said mechanism is necessary in order to convert the rotary movement of the piston motor into a stroke movement of the piston since, without high-outlay measures, the alternating-current motors used can
25 be operated only in one rotary direction.

 Such a mechanism, however, has three basic disadvantages;

1. It renders the coffee machine considerably more expensive.
- 30 2. It is susceptible to disruption and is exposed to a certain amount of wear, with the result that the maintenance outlay is consequently relatively high.
3. It increases the weight of the coffee machine.

35 Going by the abovementioned reasons, the obvious thing would be to use, for driving the piston, a direct-current motor which can be operated in two rotary directions without any difficulty. However, the use of a direct-current motor, in turn, entails other disadvantages:

1. A direct voltage has to be provided in order to operate a direct-current motor.
2. Direct-current motors, which are very much possible from a financial point of view, generally have an operating voltage of less than 80 V. Consequently, the a.c. supply voltage of e.g. 220 V has to be transformed to the voltage necessary for operating the direct-current motor and rectified. Such a transformer, however, would cancel out again the advantages, in terms of weight and price, mentioned for a direct-current motor.

A further disadvantage of espresso coffee machines consists, in addition, in that, in particular if an espresso is prepared (small quantity of brewed-up water) and a pre-heated cup is not used, the coffee beverage which has been prepared is usually already relatively cold when it is drunk.

The object of the invention is thus further to develop a coffee machine of the generic type such that use can be made, for driving the piston, of a direct-current motor which can be operated in two different rotary directions and can be connected to the power supply without complex circuitry, a further intention being, with a low degree of outlay, to provide a heating device by means of which coffee cups can be pre-heated such that, even when an "espresso coffee" is prepared, the latter is deemed sufficiently hot when it is drunk.

According to the invention, this object is achieved by the features defined in the characterizing part of Patent Claim 1.

In order that the connection to the power supply (alternating voltage with 110 or 220 V) is made possible without complex circuitry, a voltage divider having an electric resistor may be provided with a series-connected diode. Preferably, the electric resistor is effective, during the operation of the direct-current piston motor, both as a series resistor for said motor and as a heating element for a heating plate.

Such espresso coffee machines of the generic type

generally have, for control purposes, a microprocessor integrated into a control unit. It is thus possible, without a large degree of extra expenditure, to activate the series resistor via this control unit such that said
5 series resistor can also be activated on its own, without the direct-current piston motor being in operation, as a heating element for heating up the heating plate, and that, in addition, the heating capacity can be varied.

Since the series resistor used for restricting
10 the voltage is also used as a heating element for the heating plate, the power loss which occurs, on the one hand, can be utilized expediently, and, on the other hand, consequently renders superfluous a unit heater for cooling said series resistor.

15 Further developments and preferred embodiments of the subject matter of the invention are described in the dependent Claims 2 to 9.

An exemplary embodiment of the subject matter of the invention is illustrated in more detail hereinbelow
20 with reference to the accompanying drawings, in which:

Fig. 1 shows a schematic longitudinal section through the espresso coffee machine according to the invention, in order to illustrate the basic principle; and

25 Fig. 2 shows a block diagram of the electrical circuitry.

The coffee machine represented schematically in longitudinal section in Figure 1 exhibits a housing 30, a cold-water vessel 1, a hot-water preparer 2, which is
30 configured in this example as an instantaneous heater, and a pump 3 for delivering the water. The direct-current piston motor designated by 4 is connected in series with a series resistor 6 which, on the one hand, restricts the applied voltage on the direct-current piston motor 4 and,
35 on the other hand, serves as a heating element 16 for a heating plate 7. Said direct-current piston motor 4 drives, via a pinion 8, a rack 9 which bears a piston 5 at its end, the latter compacting the coffee powder 10 located in an infusion chamber 12. The ground coffee

powder from the storage vessel 20 is metered into the infusion chamber 12 via a feedline 21.

In order to brew up the coffee, the piston 5 moves into the infusion chamber 12 to such an extent that the coffee powder 10 is compacted to a predetermined value. When the piston 5 then bears on the coffee powder 10 with a defined force, the actual brewing procedure begins. For this purpose, the heated water 11 which is under pressure is guided, via hot-water feedline 14, through the piston 5; there, it can be discharged through a sieve 13, fitted at the bottom end of the piston, in order then to be able to flow through the coffee powder 10. The brewed-up coffee beverage is finally discharged through a coffee sieve 22 fitted at the bottom end of the infusion chamber and then flows into the coffee cup 25.

After the brewing procedure, the used coffee powder is removed in a manner which is known per se, but is not described here in any more detail.

In order to bring the coffee cups 25 as easily as possible to a specific temperature, the heating element 16 is automatically activated via the control means S1 when the coffee machine is switched on. In this arrangement, it can be assumed that the coffee cups 25 located on the heating plate 7 of the coffee machine are pre-heated to the desired temperature even only a few minutes after the coffee machine has been switched on.

Figure 2 shows the principle electrical circuitry for activating the direct-current piston motor M1 and an electric resistor R1 which is connected in series therewith.

A control unit designated by S1 has three outputs. Connected to the first output is a driver stage L1, to the second output a driver stage L2 and to the third output a phase-control or wave-packet-control circuit L3. The output of the driver stage L1 is connected to a triac designated by TR1 and, in series therewith, to a diode D1 which is connected in the reverse direction. The other connection of the diode D1, the anode, is connected to one pole of the motor M1. Connected to the output of the

driver stage L2 is a triac designated by TR2 and, in series therewith, a diode D2 which is connected in the conducting direction. The cathode of the diode D2 is connected to the same pole of the motor M1 as the anode of the diode D1. Finally, the output of the phase-control or wave-packet-control circuit L3 is connected to the other pole of the direct-current piston motor, to which the electric resistor R1 is also connected. Connected in parallel with the motor M1 are two overvoltage-protection circuits U1 and U2, which are connected in opposition.

Upon operation of the direct-current piston motor M1, the applied supply voltage (220 V) is restricted by the series-connected series resistor R1. If the direct-current piston motor M1 is then to be driven in one rotary direction, namely in order to displace the piston 5 (Figure 1) downwards, then it is activated via the driver stage L1, which triggers the triac TR1. The diode D1 is connected in series with the motor M1 and the triac TR1. Since the anode of the diode D1 is connected to the motor M1, the negative half-waves of the diode D1 are blocked, with the result that only the positive half-waves of the supply voltage are used in order to drive the direct-current piston motor M1. This means that the direct-current piston motor M1 is subjected only to one voltage, which has an identical polarity (in this case positive).

Correspondingly, the same obviously applies for the other rotary direction and thus the upwards displacement of the piston, except that, for the activation of the motor M1 in this case, use is then made of the driver stage L2 with the triac TR2 and the diode D2. In contrast to the diode D1, the diode D2 has an opposite conducting direction, with the result that only the positive half-waves are blocked by the diode D2 and thus the negative half-waves are used in order to drive the direct-current piston motor M1.

Voltage peaks, which could be hazardous for the direct-current piston motor M1, are intercepted by the overvoltage-protection circuits U1 and U2, which are

located in parallel with the motor M1. This is the case both for positive and for negative half-waves. The smoothing of these half-waves is rendered superfluous, since the direct-current piston motor M1, together with the rack 9 (Figure 1), has a relatively large moment of inertia, with the result that despite a pulsating direct voltage across the direct-current piston motor, a continuous movement of the piston is achieved. The power converted into heat in the series resistor R1 during the operation of the motor M1 is used to heat up the heating plate 7 (Figure 1).

If the intention is only to pre-heat the coffee cups without the direct-current piston motor M1 being operated, then the electric resistor R1 provided for heating up the heating plate can be activated via the phase-control or wave-packet-control circuit L3 without the motor M1 being in operation. The regulation of the power for pre-heating the cups is likewise made possible via the phase-control or wave-packet-control circuit L3 in a manner which is known, but is not described here in any more detail.

The microprocessor present in such coffee machines of the generic type is accommodated in the control unit S1. Said control means ensures that inexpedient or impermissible activations do not take place. It thus has to make sure, for example, that only in each case one of the two driver stages L1 or L2 activates the direct-current electric motor, and that the series resistor R1, via the phase-control or wave-packet-control circuit L3, does not act together with one of the two driver stages L1 or L2.

Since the direct-current piston motor defines the stroke path of the piston directly via a rack, it is possible to regulate the direct-current piston motor such that the coffee powder is always compacted uniformly to the optimum extent, irrespective of the metered amount. In the case of the alternating-current motors used hitherto, which have only one rotary direction and convert this rotary movement into a stroke movement via

a high-outlay mechanism (for example a crankshaft), the compaction of the coffee powder cannot be varied in dependence on the amount of coffee metered since the stroke path of the piston is predetermined and constant.



Patent Claims

1. Coffee machine, in particular expresso coffee machine, which exhibits a cold-water vessel (1), a pump (3) for delivering the water, a hot-water preparer (2),
5 an infusion chamber (12) for receiving the coffee powder (10), and a piston (5) which is driven by a reversible piston motor (4) and is intended for compacting the coffee powder (10) located in the infusion chamber (12), characterized in that the piston motor (4) is configured
10 as a direct-current motor (4) operated by a lower voltage than the supply voltage, and it is provided, for voltage adaptation, with an electric resistor (6) which is connected in series therewith, in that the piston motor (4) can be reversed with the aid of rectifier elements
15 (D1, D2), and in that a heating plate (7) is provided in order to pre-heat cups or to keep the beverage warm, in the case of which the electric resistor (6) serves as a heating element (16) for the heating plate (7).
2. Apparatus according to Claim 1, characterized in
20 that the electric resistor (6) can also be activated as an effective heating element (16) independently of the direct-current piston motor (4).
3. Apparatus according to Claim 1, characterized in
25 that the heating element (16) is in the form of a heating coil.
4. Apparatus according to Claim 1, characterized in
that the heating element (16) is thermally coupled to the heating plate (7).
5. Apparatus according to Claim 4, characterized in
30 that the heating plate (7) serves to pre-heat coffee cups (25).
6. Apparatus according to Claim 5, characterized in
that the heating plate (7) is configured as a top housing covering (17).
- 35 7. Apparatus according to Claim 1, characterized in
that the heating plate (7) consists of metal.
8. Apparatus according to Claim 2, characterized in
that means are provided which automatically activate the heating element (16) for heating up the heating plate (7)



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when the coffee machine is switched on.

9. Apparatus according to Claims 2 and 8, characterized in that the switching-on period, and thus the heating capacity of the heating element (16), can be
- 5 controlled by phase control or wave-packet control.