

(12) STANDARD PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2014317397 B2**

- (54) Title
An induction cooking hob including a cooking area with three or more induction coils and a method for controlling a cooking area
- (51) International Patent Classification(s)
H05B 6/06 (2006.01) **H05B 6/12** (2006.01)
- (21) Application No: **2014317397** (22) Date of Filing: **2014.07.22**
- (87) WIPO No: **WO15/032542**
- (30) Priority Data
- | | | |
|-------------------|-------------------|--------------|
| (31) Number | (32) Date | (33) Country |
| 13183161.2 | 2013.09.05 | EP |
- (43) Publication Date: **2015.03.12**
(44) Accepted Journal Date: **2018.09.20**
- (71) Applicant(s)
Electrolux Appliances Aktiebolag
- (72) Inventor(s)
Christiansen, Svend Erik;Martini, Filippo;Nostro, Massimo;Viroli, Alex;Jeanneteau, Laurent
- (74) Agent / Attorney
Halfords IP, 1 Market Street, Sydney, NSW, 2000, AU
- (56) Related Art
EP 2034800 A1

(43) International Publication Date
12 March 2015 (12.03.2015)

- (51) International Patent Classification:
H05B 6/06 (2006.01) *H05B 6/12* (2006.01)
- (21) International Application Number:
PCT/EP2014/065731
- (22) International Filing Date:
22 July 2014 (22.07.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
13183161.2 5 September 2013 (05.09.2013) EP
- (71) Applicant: ELECTROLUX APPLIANCES AK-
TIEBOLAG [SE/SE]; S:t Göransgatan 143, S-105 45
Stockholm (SE).
- (72) Inventors: CHRISTIANSEN, Svend Erik; Viale Bo-
logna, 298, I-47122 Forlì (IT). MARTINI, Filippo; Viale
Bologna, 298, I-47100 Forlì (IT). NOSTRO, Massimo;
Viale Bologna, 298, I-47122 Forlì (IT). VIROLI, Alex;
Viale Bologna, 298, I-47122 Forlì (IT). JEANNETEAU,
Laurent; Viale Bologna, 298, I-47122 Forlì (IT).
- (74) Agent: BAUMGARTL, Gerhard; 1036, 90327 Nürnberg
(DE).
- (81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

- (84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

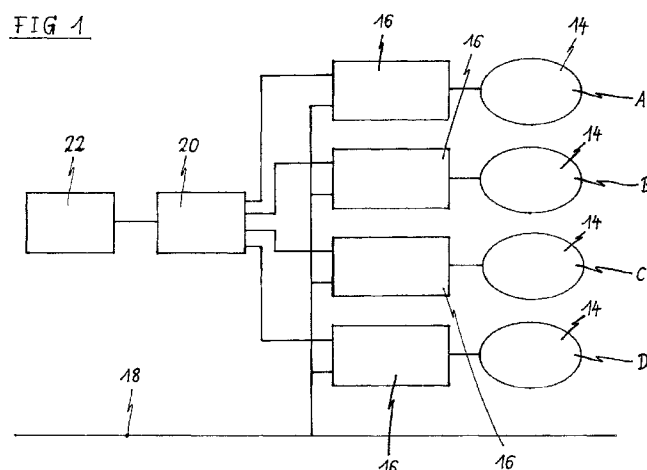
Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

— with international search report (Art. 21(3))

(54) Title: AN INDUCTION COOKING HOB INCLUDING A COOKING AREA WITH THREE OR MORE INDUCTION COILS AND A METHOD FOR CONTROLLING A COOKING AREA



(57) Abstract: The present invention relates to an induction cooking hob (10) including at least one cooking area (12), wherein the cooking area (12) comprises at least three induction coils (14). The induction coils (14) of at least one cooking area (12) are arranged side-by-side and in series. Each induction coil (14) of at least one cooking area (12) has an elongated shape. The longitudinal axes of the induction coils (14) within one cooking area (12) are arranged in parallel. Each induction coil (14) of the cooking area (12) is associated with a dedicated induction generator (16). The induction generators (16) are connected or connectable to at least one current line (18). The induction generators (16) are connected to and controlled or controllable by at least one control unit (20). Requested powers (rP) for each used induction generator (16) are adjusted or adjustable independent from each other by a user interface (22). Instant powers (iP) of the induction generators (16) within a cycle pattern (T1, T2, ..., T11) are controlled or controllable independent from each other by the control unit (20). Further, the present invention relates to a method for controlling a cooking area.

2014317397 30 Jul 2018

An induction cooking hob including a cooking area with three or more induction coils and a method for controlling a cooking area

Field of the invention

5 The present invention relates to an induction cooking hob including at least one cooking area comprises at least three induction coils. Further, the present invention relates to a method for controlling a cooking area.

Background of the invention

0 On cooking hobs, in particular on induction cooking hobs, there is a present trend that the cooking zones are not arranged in fixed places, but are flexibly put together by one or more heating elements. Cookware may be put onto an arbitrary position of
5 the cooking area by the user. A pot detection device recognizes said position, so that the heating elements below the cookware may be activated.

10 However, it is difficult to set the appropriate powers for the relevant heating elements. Further, audible interference may be generate, if the difference between the instant powers of adjacent activated induction coils corresponds with differences between frequencies within the range of audible interference.

Summary of the invention

25 It is an object of the present invention to provide an improved induction cooking hob with a cooking area and an improved method for controlling the power of the induction coils of the cooking area.

30 The induction cooking hob according to the present invention includes at least one cooking area, wherein:

- the cooking area comprises at least three induction coils,
 - the induction coils of at least one cooking area are arranged side-by-side,
- 35

2014317397 30 Jul 2018

- each induction coil of at least one cooking area has an elongated shape,
- the longitudinal axes of the induction coils within one cooking area are arranged in parallel,
- 5 - each induction coil of the cooking area is associated with a dedicated induction generator,
- the induction generators are connected or connectable to at least one current line,
- the induction generators are connected to and controlled or controllable by at least one control unit,
- 0 - requested powers for each used induction generator are adjusted or adjustable independent from each other by a user interface, and
- instant powers of the induction generators within a cycle
- 5 pattern are controlled or controllable independent from each other by the control unit.

The main idea of the present invention is the geometric properties of the cooking area and the induction coils on the one hand

10 and the dedicated induction generator for each induction coil of the cooking area on the other hand. The geometric properties of the cooking area and the induction coils allow a number of arrangements of cookware with different shapes. The dedicated induction generator for each induction coil allows an independent

25 setting of power of each induction coil.

Preferably, the induction coils of at least one cooking area have an oval and/or elliptical shape.

30 For example, the induction generators are connected or connectable to the same current line.

Alternatively, the induction generators are connected or connectable to at least two different current lines, wherein said

35 current lines have different phases.

2014317397 30 Jul 2018

Further, the control unit may be provided for performing at least one cooking mode, wherein the activated induction coils work with one single setting of the requested power.

Moreover, the control unit may be provided for performing at least one cooking mode with at least two different settings of requested powers, wherein at least one activated induction coil works with the setting of one requested power and at least one other activated induction coil works with the setting of another requested power.

In particular, the cooking area comprises four induction coils.

Furthermore, the induction cooking hob may comprise a number of pot detection devices, wherein each induction coil is associated to at least one pot detection device.

According to the present invention, the method is provided for controlling a cooking area on an induction cooking hob, wherein the cooking area comprises at least three induction coils and said method comprises the steps of:

- setting a requested power for each used induction coil by a user interface,
- selecting a number of subsequent cycle patterns from a table stored in a memory of a control unit,
- defining activated and deactivated induction coils by each selected cycle pattern,
- determining a cycle time for each selected cycle pattern and a power balance between the activated induction coils, so that a desired average power for each induction coil is obtained over a period of one or more selected cycle patterns, and

2014317397 30 Jul 2018

- the sum of the instant powers of the activated induction coils within each selected cycle pattern is equal to the sum of the requested powers for each used induction coil.

5 Preferably, the difference between the instant powers of adjacent activated induction coils is small enough, so that the difference between frequencies associated to the instant powers avoids the generation of audible interference. In particular, the difference between said frequencies is less than 1000 Hz.

0 Further, the desired average power for each induction coil over the period of one or more selected cycle patterns may be equal to the requested power for said induction coil.

5 Preferably, as many induction coils as possible are activated within one cycle patterns.

In a similar way, the instant powers of the activated induction coils may be as low as possible.

10 In particular, variations of the instant powers of the activated induction coils are as low as possible.

25 At last, the method is provided for the induction cooking hob mentioned above.

Brief description of the drawings

The present invention will be described in further detail with reference to the accompanied drawings, in which

30 FIG 1 illustrates a schematic circuit diagram of a cooking area for an induction cooking hob according to a preferred embodiment of the present invention,

FIG 2 illustrates a schematic top view of the induction cooking hob according to the preferred embodiment of the present invention, and

FIG 3 illustrates a further schematic top view of the induction cooking hob according to the preferred embodiment of the present invention.

Detailed description of the embodiment or embodiments

FIG 1 illustrates a schematic circuit diagram of a cooking area 12 for an induction cooking hob 10 according to a preferred embodiment of the present invention.

The cooking area 12 comprises four induction coils 14 arranged side-by side. In this example, the four induction coils 14 form a line. A first, second, third and fourth induction coil 14 is denoted by the letter A, B, C and D, respectively. Further, the cooking area 12 comprises four induction generators 16, a current line 18, a control unit 20 and a user interface 22. The current line 18 is provided for supplying rectified mains voltage. The current line 18 is connected to power input terminals of the four induction generators 16. Each induction generator 16 corresponds with one induction coil 14. An output terminal of each induction generator 16 is connected to the associated induction coil 14. The user interface 22 is connected to an input terminal of the control unit 20. Four output terminals of the control unit 20 are connected to corresponding control input terminals of the induction generators 16. For example, the induction generator 16 is realized by a half-bridge inverter. Each induction coil 14 is associated to at least one pot detection device.

By operating the user interface 22 different cooking modes can be selected by a user. For example, the user interface 22 may comprise dedicated touch keys for said cooking modes. In a pre-

2014317397 30 Jul 2018

ferred embodiment the following four cooking modes are provided. According to a first cooking mode, the four induction coils A, B, C and D work with one single power setting. According to a second cooking mode, the four induction coils A, B, C and D work with two different power settings, wherein the first and second induction coils A and B work with one power setting and the third and fourth induction coils C and D work with another power setting. According to a third cooking mode, the four induction coils A, B, C and D work with two different power settings, wherein the first induction coil A works with one power setting and the second, third and fourth induction coils B, C and D work with another power setting. According to a fourth cooking mode, the four induction coils A, B, C and D work with two different power settings, wherein the first, second and third induction coils A, B and C work with one power setting and the fourth induction coil D works with another power setting. The third and fourth cooking modes are the same in view of a functional aspect.

In the first cooking mode, the induction coils 14 covered by cookware are activated at the same working frequency in order to cancel acoustic interference noise. However, in the second, third and fourth cooking modes, the induction coils 14 are affected by different power settings and therefore by different frequencies, so that acoustic interference noise has to be avoided. The acoustic interference noise occurs, if the frequency difference between adjacent induction coils 14 is within the audible range of the human ear. Since the power is set by the user, the frequency depends on the power setting, so that often the frequency difference may be within the audible range.

In order to avoid the acoustic interference noise, the induction coils 14 are activated and deactivated according to a number of subsequent cycle patterns T1 to T11, in which not all of the induction coils 14 are activated during the same time. The sum of

2014317397 30 Jul 2018

the instant powers iP of the activated induction coils 14 is kept in such a way that the differences of the instant powers iP between the cycle patterns T1 to T11 are small. In general, the variance of the instant powers iP must be small enough in order to comply with existing norms for flickering on the current line 18. The used cycle patterns T1 to T11 are structured in such a way that adjacent activated induction coils 14 have a small or no frequency difference. In contrast, the activated induction coils 14, which are not adjacent, may have different frequencies and powers.

The induction coils 14 activated at a certain time should have a total instant power iP , which is equal to the sum of all requested powers rP . However, a variation of the total instant power iP between the cycle patterns T1 to T11 may be allowed with the scope of the EMC norms.

The following table illustrates the possible combinations of activated and deactivated induction coils A, B, C and D, in which two, three or four of the induction coils A, B, C and D are activated at the same time. The first induction coil A is adjacent to the second induction coil B, in turn the second induction coil B is adjacent to the third induction coil C, and the third induction coil C is adjacent to the fourth induction coil D, as shown in FIG 1. The second line to the fifth line of said table indicate the activated and deactivated states of the induction coils A, B, C and D, respectively. The eleven different cycle patterns are denoted by T1 to T11 in the first line. The last line of the table indicates the number N of the simultaneously activated induction coils A, B, C and D.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11
A	x	x	x	x		X		x			x
B	x	x	x		x		x	x		X	

C	x	x		x	x	X			x	X	
D	x		x	x	x		x		x		x
N	4	3	3	3	3	2	2	2	2	2	2

A number of the cycle patterns T1 to T11 is selected from the above table. A relative cycle time t for each selected cycle pattern T1 to T11 and a power balance between the induction coils A, B, C and D is set in such a way, that the desired average power for each induction coil A, B, C and D is achieved over one or more cycle patterns T1 to T11. The instant power iP of the individual induction coils A, B, C and D depends on the number of activated induction coils A, B, C and D, the selected power balance and the total requested power rP . It is preferred, that as many induction coils A, B, C and D as possible are activated within the given cycle pattern T1 to T11, so that the variation of the instant powers iP of the induction coils A, B, C and D are minimized, and that the power is uniform.

The following table illustrates the default individual duty settings of the induction coils A, B, C and D for each cycle pattern T1 to T11. The numerical values in the second line to the fifth line of said table indicate the percentages of the power of the induction coils A, B, C and D, respectively. The last line of the table indicates the number N of the simultaneously activated induction coils A, B, C and D.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11
A	0.25	0.33	0.33	0.33		0.5		0.5			0.5
B	0.25	0.33	0.33		0.33		0.5	0.5		0.5	
C	0.25	0.33		0.33	0.33	0.5			0.5	0.5	
D	0.25		0.33	0.33	0.33		0.5		0.5		0.5
N	4	3	3	3	3	2	2	2	2	2	2

2014317397 30 Jul 2018

In particular, the cycle patterns T6, T7 and T11 can be selected as the preferred last cycle patterns, wherein the power balance between two activated induction coils A, B, C and/or D can be adjusted in order to achieve the desired power distributions. The activated induction coils A, B, C and/or D of the cycle patterns T6, T7 and T11 are not adjacent. Thus, the activated induction coils A, B, C and/or D of the cycle patterns T6, T7 and T11 may have arbitrary frequencies without generating acoustic interference noise.

According to a first example, the requested power rP for the first induction coil A is $rP = 100\text{ W}$, for the second induction coil B is $rP = 150\text{ W}$, for the third induction coil C is $rP = 350\text{ W}$, and for the fourth induction coil D is $rP = 400\text{ W}$.

In said first example, the method of selecting the cycle patterns and setting the duty are performed as follows. A cycle pattern with three activated induction coils B, C and D is selected, wherein the induction coil A is omitted, which has a requested power rP closest to the difference between the highest and second highest requested power rP . A further cycle pattern is selected with two activated induction coils C and D having the highest and second highest requested power rP until the power is reach for the second highest power. Another cycle pattern is selected with two activated induction coils A and D having the highest requested power iP and the biggest distance from each other. The power balance of the activated induction coils A and D is adjusted in order to reach the requested power rP . Thus, the cycle patterns T5, T9 and T11 are selected.

The relative cycle time t of the cycle pattern T5 is calculated in such a way, that the lowest requested power rP of the activated induction coils B, C or D is reached. This is the requested power $rP = 150\text{ W}$ for the second induction coil B. Further,

the sum of the instant powers iP of the activated induction coils B, C and D is equal to the sum of the requested powers rP for the induction coils A, B, C and D, which is $rP = 1000$ W. The relative cycle time t of the cycle pattern T5 is given by:

$$t(T5) = iP(B) / (rP(A,B,C,D)/3) = 150 \text{ W} / (1000 \text{ W} / 3) = 0.45$$

The relative cycle time t of the cycle pattern T9 is calculated in such a way, that the instant power iP of the third induction coil C during the cycle pattern T5 is reached. Said instant power iP of the third induction coil C during the cycle pattern T5 is given by:

$$iP(C;T5) = (rP(A,B,C,D)/3) * t(T5) = (1000 \text{ W}/3) * 0.45 = 150 \text{ W}$$

In the cycle pattern T9 there are two activated induction coils C and D, so that the instant power iP of each activated induction coil C and D is given by:

$$iP(C) = iP(D) = rP(A,B,C,D)/2 = 1000 \text{ W} / 2 = 500 \text{ W}.$$

The remaining power of the third induction coil C during the cycle pattern T9 is given by:

$$iP(C;T9) = rP(C) - iP(C;T5) * t(T5) = 200 \text{ W}$$

The relative cycle time t of the cycle pattern T9 is given by:

$$t(T9) = iP(C;T9) / (rP(A,B,C,D)/2) = 200 \text{ W} / (1000 \text{ W} / 2) = 0.4$$

The relative cycle time t of the cycle pattern T11 is given as the remaining time.

$$t(T11) = 1 - t(T5) - t(T9) = 1 - 0.45 - 0.40 = 0.15$$

Since the two remaining activated induction coils A and D are not adjacent, the power balance of said two induction coils A and D can be arbitrarily adjusted in order to obtain the desired power for both induction coils A and D. The instant powers iP of the activated induction coil A and D are given by

$$iP(A;T11) = rP(A) / t(T11) = 100 \text{ W} / 0.15 = 666.7 \text{ W}$$

$$iP(D;T11) = 1 - iP(A;T11) = 333.3 \text{ W}$$

The actual power aP of the fourth induction coil can be verified by:

$$aP(D) = 1000 \text{ W} * (0.45 / 3 + 0.4 / 2) + 333.3 \text{ W} * 0.15 = 400 \text{ W}$$

The following table illustrates the relative cycle times t , the instant powers iP , the actual powers aP and the requested powers rP of the cycle patterns T1 to T11 according to the first example.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	aP	rP
t	0	0	0	0	0.45	0	0	0	0.40	0	0.15		
$iP(A)$					0				0		666.7	100	100
$iP(B)$					333				0		0	150	150
$iP(C)$					333				500		0	350	350
$iP(D)$					333				500		333.3	400	400
Sum					1000				1000		1000	1000	1000

According to a second example, the cooking zones associated to the second, third and fourth induction coils B, C and D are always linked. In the second example, other combinations of cycle patterns are used.

30 Jul 2018

2014317397

FIG 2 illustrates a schematic top view of the induction cooking hob 10 according to the preferred embodiment of the present invention. A small cooking vessel 28 and a big cooking vessel 30 are arranged on the induction cooking hob 10. FIG 2 relates to the second example.

The induction cooking hob 10 comprises a cooking area 12 including the four induction coils 14 arranged in series. Moreover, the induction cooking hob 10 comprises two further induction coils 24 and 26. The four induction coils 14 are elliptical, while the further induction coils 24 and 26 are circular. The longitudinal axes of the four induction coils 14 are arranged in parallel. The small cooking vessel 28 is arranged above the first induction coil A, while the big cooking vessel 30 is arranged above the second, third and fourth induction coils B, C and D. The positions of the small cooking vessel 28 and the big cooking vessel 30 relates to the second example.

The second example differs between two cases. In a first case the power setting of the first induction coil A is lower than the individual requested powers rP of the other induction coils B, C and D, while in a second case the power setting of the first induction coil A is higher than the individual requested powers rP of the other induction coils B, C and D.

In the first case the cycle patterns T1 and T5 are applied. The cycle pattern T1 is applied until the requested power for the first induction coil A is reached, while the cycle pattern T5 is applied during the rest of the time.

The sum of the instant powers iP of all activated induction coils A, B, C and/or D is always equal to the sum of the requested powers rP . In the cycle pattern T1 there are four activated induction coils A, B, C and D, so that the instant powers

of each induction coil A, B, C and D is a quarter of the sum of the requested powers. The sum of the requested powers rP is:

$$rP(A,B,C,D) = 100 \text{ W} + 300 \text{ W} + 300 \text{ W} + 300 \text{ W} = 1000 \text{ W}$$

The relative cycle time t of the cycle pattern T1 is given by:

$$t(T1) = iP(A) / (rP(A,B,C,D)/4) = 100 \text{ W} / (1000 \text{ W} / 4) = 0.4$$

The remaining relative cycle time t of the cycle pattern T5 is given by:

$$t(T5) = 1 - t(T1) = 1 - 0.4 = 0.6$$

The following table illustrates the relative cycle times t , the instant powers iP , the actual power aP and the requested powers rP of the cycle patterns T1 to T11 according to the first case of the second example.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	aP	rP
t	0.4	0	0	0	0.6	0	0	0	0	0	0	1	
$iP(A)$	250											100	100
$iP(B)$	250				333.3							300	300
$iP(C)$	250				333.3							300	300
$iP(D)$	250				333.3							300	300
Sum	1000				1000							1000	1000

In the second case the power setting of the first induction coil A is higher than the individual requested powers rP of the other induction coils B, C and D.

In the second case the cycle patterns T2 and T11 are applied. The cycle pattern T2 is applied until the requested powers for

30 Jul 2018

2014317397

the second and third induction coils B and C are reached. In the cycle pattern T11 the instant powers of the first and fourth induction coils A and D are matched in order to obtain the requested powers for said first and fourth induction coils A and D.

The sum of the instant powers iP is always equal to the sum of the requested powers rP . In the cycle pattern T2 there are three activated induction coils A, B and C, so that the instant power of each induction coil A, B and C is a third of the sum of the requested powers. The sum of the requested powers rP is:

$$rP(A,B,C,D) = 300 \text{ W} + 100 \text{ W} + 100 \text{ W} + 100 \text{ W} = 600 \text{ W}$$

The instant power iP of each induction coil A, B and C during the cycle pattern T2 is

$$iP(A) = iP(B) = iP(C) = rP(A,B,C,D)/3 = 200 \text{ W}$$

The relative cycle time t of the cycle pattern T2 is given by:

$$t(T2) = rP(B) / (rP(A,B,C,D)/3) = 100 \text{ W} / (600 \text{ W} / 3) = 0.5$$

The remaining relative cycle time t of the cycle pattern T11 is given by:

$$t(T11) = 1 - t(T2) = 1 - 0.5 = 0.5$$

Since the two remaining activated induction coils A and D are not adjacent, the power balance of said two induction coils A and D can be arbitrarily adjusted in order to obtain the desired power for both induction coils A and D.

The instant powers iP of the activated induction coil A and D are given by

$$iP(D;T11) = rP(D) / t(T11) = 100 \text{ W} / 0.5 = 200 \text{ W}$$

$$iP(A;T11) = rP(A,B,C,D) - iP(D;T11) = 600 \text{ W} - 200 \text{ W} = 400 \text{ W}$$

The actual power aP of the first induction coil A can be verified by:

$$aP(A) = (600 \text{ W} * 0.5)/3 + (400 \text{ W} * 0.5) = 300 \text{ W}$$

The following table illustrates the relative cycle times t , the instant powers iP , the actual powers aP and the requested powers rP of the cycle patterns T1 to T11 according to the second case of the second example.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	aP	rP
t	0	0.5	0	0	0	0	0	0	0	0	0.5	1	
iP(A)		200									400	300	300
iP(B)		200										100	100
iP(C)		200										100	100
iP(D)											200	100	100
Sum		600									600	600	600

FIG 3 illustrates a further schematic top view of the induction cooking hob according to the preferred embodiment of the present invention. Two medium cooking vessels 32 and 34 are arranged on the induction cooking hob 10. FIG 3 relates to an example with two current lines on different phases.

The induction cooking hob 10 comprises the cooking area 12 including the four induction coils 14 arranged in series. Additionally, the induction cooking hob 10 comprises the two further induction coils 24 and 26. The four induction coils 14 are elliptical, while the further induction coils 24 and 26 are circular. The longitudinal axes of the four induction coils 14 are arranged in parallel. A first medium cooking vessel 32 is arranged above the first induction coil A and the second induction coil B, while a second medium cooking vessel 34 is arranged above the third induction coil C and the fourth induction coil D. The first induction coil A and the second induction coil B are supplied by a first current line, while the third induction coil C and the fourth induction coil D are supplied by a second current line, wherein the first and second current lines are on different phases.

In order to avoid the acoustic interference noise, the adjacent induction coils A, B, C and/or D cannot be activated at the same time with a frequency difference within the audible range. The

sum of the instant powers iP of the first and second induction coils A and B should be constant. In a similar way, the sum of the instant powers iP of the third and fourth induction coils C and D should also be constant.

The following table illustrates the possible cycle patterns T1 to T3.

	T1	T2	T3
A	x	x	
B	x		x
C	x	x	
D	x		x

The following table illustrates the relative cycle times t , the instant powers iP , the actual powers aP and the requested powers rP of the cycle patterns T1 to T3 according to an example, in which the first induction coil A and the second induction coil B are supplied by the first current line, while the third induction coil C and the fourth induction coil D are supplied by the second current line, wherein the first and second current lines are on different phases.

	T1	T2	T3		aP	rP
t	0	0.5	0.5			
$iP(A)$	350	980	0		490	500
$iP(B)$	350	0	980		490	500
$iP(C)$	350	420	0		210	200
$iP(D)$	350	0	420		210	200
Sum	1400	1400	1400			1400

2014317397 30 Jul 2018

If the sum of the requested powers rP of the first induction coil A and the second induction coil B is equal or about equal to the sum of the requested powers rP of the third induction coil C and the fourth induction coil D, then the cycle pattern T1 is applied the full time. However, if the above requested powers are different, then the cycle patterns T2 and T3 are applied, wherein the relative cycle time t is 0.5 or 50 %. The sum of the instant powers iP of the first induction coil A and the second induction coil B is equal to the sum of the corresponding requested powers rP . In a similar way, the sum of the instant powers iP of the third induction coil C and the fourth induction coil D is equal to the sum of the corresponding requested powers rP .

Another application of the present invention is the activation of a further cooking mode, wherein the requested power (rP) changes automatically according to the position of the cooking vessel on the cooking area. The system performs a pot detection on all coils in the cooking area. Depending on which coil or coils) that is (are) covered by the cooking vessel, power is applied to the coil (coils) according to a preset pattern. The requested power (rP) can for instance be low, for example about 400 W, if the cooking vessel is placed on one of the extreme parts of the cooking area. In contrast, the requested power (rP) can be high, for example about 3000 W, if the cooking vessel is placed on the other (opposite) extreme part of the cooking area. At last, the requested power (rP) can have an average value, if the cooking vessel is placed on a central portion of the cooking area, between the extreme parts. A user could be allowed to change the preset pattern from the user interface to obtain the best pattern for the cooking needs at every instance. Applied on the embodiment in FIG 1, pair of coils could be utilised as the defining regions of preset power, e.g. if a vessel is placed on coils A+B a high power is applied, if placed on coils B+C a medium power I applied and if placed on coils C+D a low power is

applied. Naturally, other combinations are possible. If a cooking vessel is moved or removed, a new pot detection can be performed to ensure that only the relevant coil or coils are active.

2014317397 30 Jul 2018 5

2014317397 30 Jul 2018

List of reference numerals

	10	induction cooking hob
	12	cooking area
5	14	induction coil
	16	induction generator
	18	current line
	20	control unit
	22	user interface
0	24	further induction coil
	26	further induction coil
	28	small cooking vessel
	30	big cooking vessel
	32	medium cooking vessel
5	34	medium cooking vessel
	A	first induction coil
	B	second induction coil
	C	third induction coil
10	D	fourth induction coil
	N	number of activated inductions coils
	Tn	cycle pattern
	t	relative cycle time
	iP	instant power
25	aP	actual power
	rP	requested power

Claims

1. An induction cooking hob including at least one cooking area, wherein:
 - the cooking area comprises at least three induction coils,
 - the induction coils of at least one cooking area are arranged side-by-side,
 - each induction coil of at least one cooking area has an elongated shape,
 - the longitudinal axes of the induction coils within one cooking area are arranged in parallel,
 - each induction coil of the cooking area is associated with a dedicated induction generator,
 - the induction generators are connected or connectable to at least one current line,
 - the induction generators are connected to and controlled or controllable by at least one control unit,
 - requested powers for each used induction generator are adjusted or adjustable independent from each other by a user interface, and
 - instant powers of the induction generators within a cycle pattern are controlled or controllable independent from each other by the control unit,
 - the sum of the instant powers of the activated induction coils within each selected cycle pattern is equal to the sum of the requested powers for each used induction coil, and
 - the cycle patterns are structured in such a way that adjacent activated induction coils have a small or no frequency difference in order to avoid acoustic interference noise, while the activated induction coils, which are not adjacent, may have different frequencies and powers.

2014317397 30 Jul 2018

2. An induction cooking hob as claimed in claim 1, wherein the induction coils of at least one cooking area have an oval and/or elliptical shape.
3. An induction cooking hob as claimed in claim 1 or claim 2, wherein the induction generators are connected or connectable to the same current line.
4. An induction cooking hob as claimed in claim 1 or claim 2, wherein the induction generators are connected or connectable to at least two different current lines, wherein said current lines have different phases.
5. An induction cooking hob as claimed in any one of the preceding claims, wherein the control unit is provided for performing at least one cooking mode, wherein the activated induction coils work with one single setting of the requested power.
6. An induction cooking hob as claimed in any one of claims 1 to 4, wherein the control unit is provided for performing at least one cooking mode with at least two different settings of requested powers, wherein at least one activated induction coil works with the setting of one requested power and at least one other activated induction coil works with the setting of another requested power.
7. An induction cooking hob as claimed in any one of the preceding claims, the cooking area comprises four induction coils.
8. An induction cooking hob as claimed in any one of the preceding claims, wherein the induction cooking hob comprises a number of pot detection devices, wherein each induction coil is associated to at least one pot detection device.

9. A method for controlling a cooking area on an induction cooking hob as claimed in any one of claims 1 to 8, wherein the cooking area comprises at least three induction coils and said method comprises the steps of:
 - setting a requested power for each used induction coil by a user interface,
 - selecting a number of subsequent cycle patterns from a table stored in a memory of a control unit,
 - defining activated and deactivated induction coils by each selected cycle pattern,
 - determining a cycle time for each selected cycle pattern and a power balance between the activated induction coils, so that a desired average power for each induction coil is obtained over a period of one or more selected cycle patterns, and
 - the sum of the instant powers of the activated induction coils within each selected cycle pattern is equal to the sum of the requested powers for each used induction coil.
10. A method as claimed in claim 9, wherein the difference between the instant powers of adjacent activated induction coils is small enough, so that the difference between frequencies associated to the instant powers avoids the generation of audible interference.
11. A method as claimed in claim 9 or claim 10, wherein the desired average power for each induction coil over the period of one or more selected cycle patterns is equal to the requested power for said induction coil.
12. A method as claimed in claim 10 or claim 11, wherein as many induction coils as possible are activated within one cycle patterns.

2014317397 30 Jul 2018

13. A method as claimed in any one of claims 9 to 12, wherein the instant powers of the activated induction coils is as low as possible.
14. A method as claimed in any one of claims 9 to 13, wherein variations of the instant powers of the activated induction coils are as low as possible.

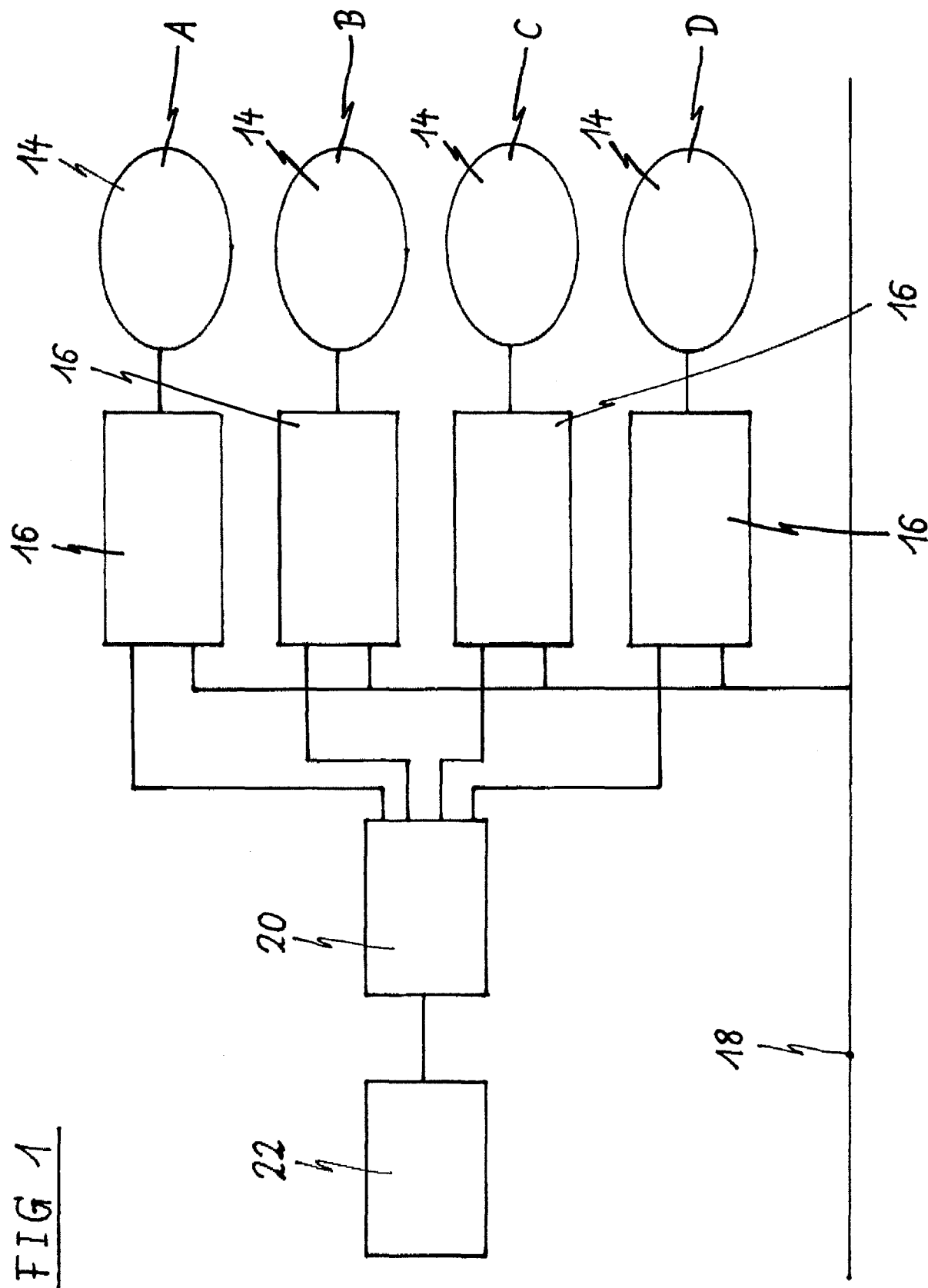


FIG 2

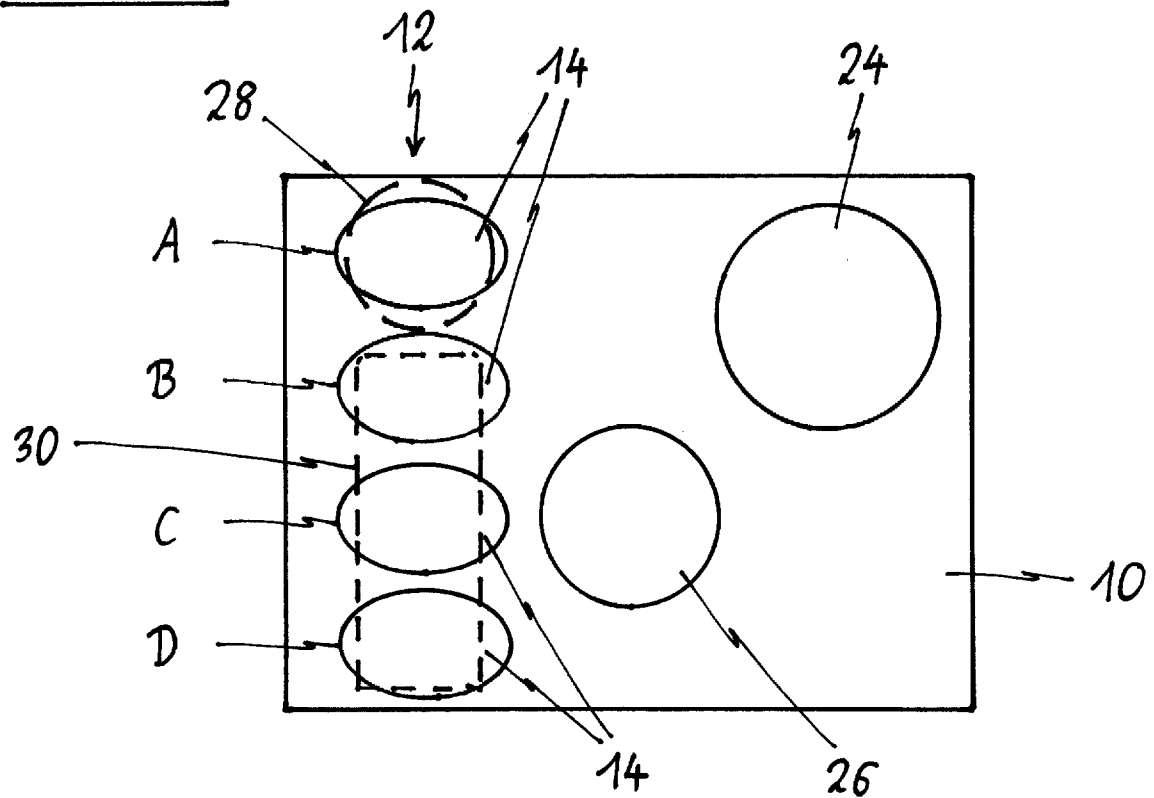


FIG 3

