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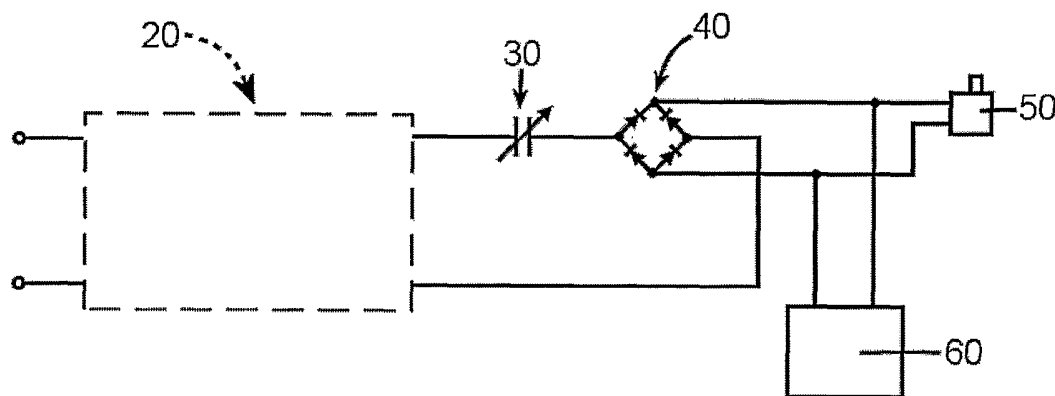
(43) International Publication Date
23 February 2006 (23.02.2006)

PCT

(10) International Publication Number
WO 2006/018599 A1

- (51) International Patent Classification⁷: **H02M 1/12**
- (21) International Application Number:
PCT/GB2005/003049
- (22) International Filing Date: 3 August 2005 (03.08.2005)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
0418453.7 19 August 2004 (19.08.2004) GB
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: REDUCING RIPPLES BY A FILTER COMPRISING A CAPACITOR AND AN INDUCTIVE REACTANCE OF AN INDUCTION MOTOR



(57) Abstract: The invention provides a circuit arrangement including an induction motor (10) capable of being driven by an alternating current power source, a rectifier (40) for rectifying the alternating current to generate direct current for driving at least one electrical device or component associated with the motor, and a filter for reducing unwanted ripple; the filter including an inductive reactance attributable to the induction motor. This arrangement promotes economy of components and achieves effective reduction or removal of unwanted ripple and other waveforms resulting from the rectification process. Preferably a capacitor (30) is provided, either in series with the inductive reactance or in shunt therewith, to create a tuned filter with the inductive reactance. It is further preferred that the inductive reactance comprises the entire lumped inductive reactance exhibited by the induction motor, and that the reactance of the capacitor is variable, so as to permit trimming of the filter to allow for changes in the inductive reactance attributable to differing operational conditions. The invention also encompasses a domestic electrical appliance incorporating a circuit arrangement of any of the foregoing kinds.



WO 2006/018599 A1

REDUCING RIPPLES BY A FILTER COMPRISING A CAPACITOR AND AN INDUCTIVE REACTANCE OF AN INDUCTION MOTOR

This invention relates to electrical circuit arrangements, and it relates more particularly to such arrangements including induction motors. It
5 relates especially to such arrangements wherein an induction motor is driven by an alternating current power source, and wherein at least one further component, and/or further circuitry of the arrangement is driven by direct current derived by rectification of the alternating current.

- 10 Such arrangements are used, for example, in domestic electrical appliances, where the induction motor drives a fan used to cool a second motor (the main drive motor of the appliance) which is driven by the direct current. An arrangement of this kind is described in EP-A-0584116; an advantage attributed to the arrangement being that, as the
15 second motor is driven harder, the operational speed of the induction motor, and thus the cooling effect of the fan, automatically increases. In its general application, however, the present invention may be applied to arrangements in which, instead of (or in addition to) a second motor, the direct current is used to drive (for example) a circuit having components,
20 such as power transistors, that require cooling.

In most circuit arrangements involving ac to dc rectification, economy of components is important, as is the removal of unwanted ripple and other waveforms from the rectification process.

25

The invention aims to address at least one of the foregoing issues and according to the invention there is thus provided a circuit arrangement

including an induction motor capable of being driven by an alternating current power source, rectifier means for rectifying the alternating current to generate direct current, at least one electrical device or component driven by the direct current, and filter means for reducing
5 unwanted ripple, wherein said filter means includes an inductive reactance attributable to the induction motor.

Preferably a capacitor is provided, either in series with the inductive reactance or in shunt therewith, to create a tuned filter with said
10 inductive reactance.

In a preferred embodiment, the said inductive reactance comprises the entire lumped inductive reactance exhibited by the induction motor, and the capacitive reactance of the capacitor is variable, so as to permit
15 trimming of the filter to allow for changes in the inductive reactance attributable to differing operational conditions.

In some embodiments of the invention, said at least one electrical device or component driven by the direct current comprises a second motor and,
20 in some such circumstances, the second motor comprises the main driving motor of a domestic appliance, and is so located physically in relation to the induction motor as to be cooled by a fan carried on the shaft of the induction motor.

25 Where such a second motor is provided, it is preferred that the second motor is disposed within a housing that is suitably vented and formed with ducting or other passageways to efficiently convey cooling air from

the fan towards the second motor, and to convey heated air away therefrom.

In alternative embodiments, the rectifier circuit powers electrical
5 circuitry that incorporates components, such as power transistors, that would benefit from cooling, or which might otherwise be usefully associated with the provision of the induction motor.

Such power transistors as aforesaid may be power transistors associated
10 with thermal control circuits in a toaster.

In some preferred embodiments, the induction motor itself comprises the prime motor driver of an electrical domestic appliance, and the electrical circuitry comprises speed and pulse control circuitry for the appliance.
15

The invention also encompasses domestic electrical appliances including circuit arrangements as aforesaid.

In order that the invention may be clearly understood and readily carried
20 into effect, one embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a diagram showing a classic equivalent circuit for an induction motor; and
25

Figure 2 is a schematic diagram showing a circuit arrangement in accordance with one example of the invention.

It is well known from induction motor theory that the induction motor can be represented by an equivalent circuit of the general kind shown in Figure 1. In accordance with the principle of the invention, inductive
5 reactance associated with the stator of an induction motor is incorporated into an input filter circuit intended to assist in smoothing unwanted ripple waveforms prior to the rectification process.

10 Referring now to Figure 2, the induction motor is represented by the equivalent circuit 10 enclosed within the dashed outline 20. A variable capacitor 30 is provided, either in series with the circuit 10 or in shunt therewith (depending upon the construction of the induction motor and the relative dimensions of its equivalent circuit components, and
15 depending upon the specific effects to be achieved thereby), to create a tuned filter with the inductive reactance of the equivalent circuit 10. The tuned filter is intended to increase the efficiency of a rectifier circuit 40, in this example a bridge rectifier, by removing, or at least reducing unwanted ripple from the input alternating current waveform. Such
20 unwanted ripple can be associated, for example, with harmonics of the power waveform frequency.

Since the inductive reactance incorporated into the filter circuit will, in general, comprise the entire lumped inductive reactance exhibited by the
25 induction motor as a whole, it is preferred (though not essential) that the co-operative capacitive reactance of the capacitor 30, against which the inductive reactance is tuned, is variable, so as to permit trimming of the

filter to allow for changes in the inductive reactance attributable to differing operational conditions.

Attached to the dc output terminals of the rectifier circuit 40 is, in this example, a second motor 50 which comprises the main driving motor of a domestic appliance, and which is so located physically in relation to the induction motor as to be cooled by a fan (not shown) carried on the shaft of the induction motor. It will be appreciated that the motor 50 may be disposed within a housing that is suitably vented and formed with ducting or other passageways to efficiently conduct the cooling air from the fan towards, and heated air away from, the motor 50.

As described above, however, the rectifier 40 may power, instead of or in addition to a motor such as 50, any kind of electrical circuitry 60 that incorporates components, such as power transistors, that would benefit from cooling, or which might otherwise be usefully associated with the provision of the induction motor. In one example, the power transistors are associated with thermal control circuits in a toaster.

In another embodiment, the induction motor itself is used as the prime motor driver of an electrical domestic appliance such as a blender, and the electrical circuitry 60 comprises speed and pulse control circuitry for the blender. In that latter embodiment, it will be appreciated that no cooling effect is provided by the induction motor; the relationship between the induction motor and the circuitry merely being that they comprise parts of a common appliance, driven respectively by ac input power and rectified dc.

CLAIMS:

1. A circuit arrangement including an induction motor capable of being driven by an alternating current power source, rectifier means for
5 rectifying the alternating current to generate direct current, at least one electrical device or component driven by the direct current, and filter means for reducing unwanted ripple, wherein said filter means includes an inductive reactance attributable to the induction motor.
- 10 2. An arrangement according to claim 1 wherein a capacitor is provided, either in series with the inductive reactance or in shunt therewith, to create a tuned filter with said inductive reactance.
3. An arrangement according to claim 2 wherein said inductive
15 reactance comprises the entire lumped inductive reactance exhibited by the induction motor.
4. An arrangement according to claim 3 wherein the capacitive reactance of the capacitor is variable, so as to permit trimming of the
20 filter to allow for changes in the inductive reactance attributable to differing operational conditions.
5. An arrangement according to any preceding claim wherein said at least one electrical device or component driven by the direct current
25 comprises a second motor.

6. An arrangement according to claim 5 wherein the second motor comprises the main driving motor of a domestic appliance, and is so located physically in relation to the induction motor as to be cooled by a fan carried on the shaft of the induction motor.

5

7. An arrangement according to claim 6 wherein the second motor is disposed within a housing that is suitably vented and formed with ducting or other passageways to efficiently convey cooling air from the fan towards the second motor, and to convey heated air away therefrom.

10

8. An arrangement according to any preceding claim wherein the rectifier circuit powers electrical circuitry that incorporates components, such as power transistors, that would benefit from cooling, or which might otherwise be usefully associated with the provision of the induction motor.

15

9. An arrangement according to claim 8 wherein the power transistors are associated with thermal control circuits in a toaster.

20 10. An arrangement according to any of claims 1 to 4 wherein the induction motor itself comprises the prime motor driver of an electrical domestic appliance, and the electrical circuitry comprises speed and pulse control circuitry for the appliance.

25 11. A circuit arrangement substantially as herein described with reference to and/or as shown in Figure 2 of the accompanying drawings.

12. A domestic electrical appliance including a circuit arrangement according to any preceding claim.

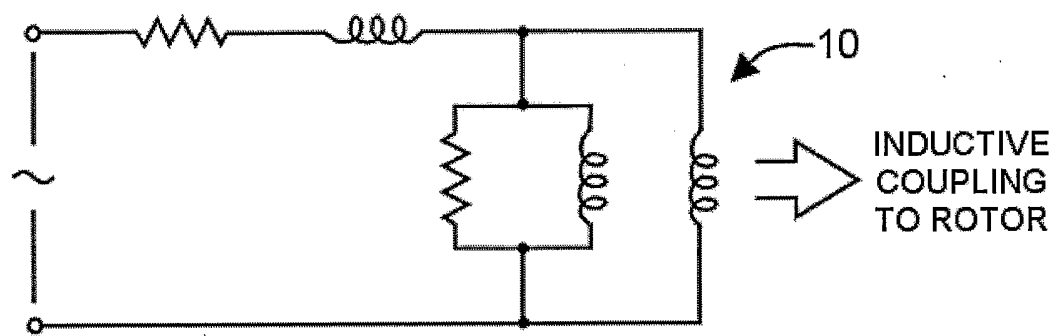


FIG 1

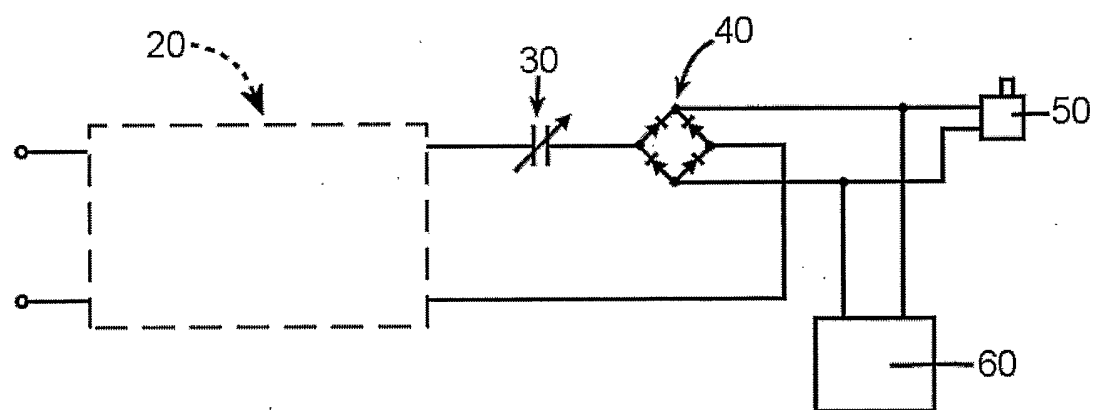


FIG 2

INTERNATIONAL SEARCH REPORT

International Application No

.../GB2005/003049

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H02M1/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H02M A47J H02P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 905 642 A (HAMMOND ET AL) 18 May 1999 (1999-05-18) figure 4 column 6, line 31 - column 7, line 2	1-4
Y	-----	5-10,12
Y	US 6 351 872 B1 (MCCORMICK MICHAEL J) 5 March 2002 (2002-03-05) abstract figures 1-3 column 4, lines 25-30,50-60 column 6, lines 8-23	5-8,12
Y	GB 2 167 288 A (* TENERET LIMITED) 29 May 1986 (1986-05-29) abstract figures 2,6 page 2, columns 34-62-71, line 39 ----- -/--	9



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- *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
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- *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 when the document is taken alone
- *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

Date of the actual completion of the international search

28 October 2005

Date of mailing of the international search report

09/11/2005

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2005/003049

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.: 11
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB2005/003049

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 5905642	A	18-05-1999	CA	2253044 A1	11-05-1999
US 6351872	B1	05-03-2002	NONE		
GB 2167288	A	29-05-1986	IE	842541 L	23-05-1986
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