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(71) Applicant: **HONEYWELL INC.**
Honeywell Plaza
Minneapolis Minnesota 55408(US)

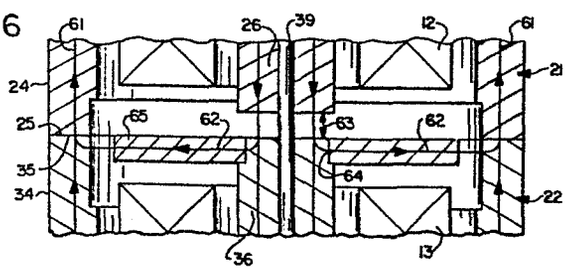
(72) Inventor: **Walker, Charles S.**
3911 N.E. 135th Street
Seattle Washington 98125(US)

(74) Representative: **Herzbach, Dieter et al,**
Honeywell Europe S.A. Holding KG Patent- und Lizenzabteilung Kaiserleistrasse 55 Postfach 184
D-6050 Offenbach am Main(DE)

(54) Pot core transformer.

(57) One or more fixed inductors may be combined in a single transformer structure by shunting a portion of the primary flux of the transformer by means of a flat member (65) high permeability or by providing an air gap (63) in the path of the primary flux (Fig. 6).

FIG. 6



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HONEYWELL INC.
Honeywell Plaza
Minneapolis, Minn., USA

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Pot Core Transformer

The present invention relates to a pot core transformer according to the preamble of claim 1.

An important goal in present day design of electrical equipment is reduction in size even when actual miniaturization is not attempted, space and volume reduction is considered desirable. One way to accomplish such reduction is to combine functions in a single device structure.

It is therefore the object of the present invention to provide an arrangement which combines in a single structure the functions of a transformer and of one or more inductors. This object is achieved by the characterizing features of independent claims 1 and 2. Further advantageous embodiments of the present invention may be taken from the sub-claims.

The present invention makes use of increasing the effective leakage inductance of a transformer winding which comprises shunting a portion of the primary flux of the transformer with a high permeability material or increasing primary flux resistance by an air gap.

With respect to embodiments shown in the figures of the attached drawing in which like reference numerals identify corresponding elements throughout the several views the present invention shall be further explained. In those

figures

Fig.1 is a wiring diagram illustrative of the invention;

Fig.2 is an exploded view of a device according to the invention shown schematically;

Fig.3 is an axial sectional view of the device of Fig.2;

Fig.4 and 5 are fragmentary sectional views similar to Fig.3, showing other embodiments of the invention;

Fig.6 is an axial sectional view of a further embodiment of the invention;

Fig.7 and 8 show the principal of the invention applied to a transformer having more than two windings; and

Fig.9 and 10 are separate equivalents of the structures of Fig. 7 and 8 respectively.

The invention comprises modification of a "pot core" transformer to add the function of one or more additional inductances without changing the characteristics of the device as a transformer.

Fig. 1 shows that one embodiment of the device may include a transformer 10, having a core 11, a primary winding 12, and a secondary winding 13, combined with a fixed inductance 14 in serie with winding 13, and if desired, a fixed inductance 15 in parallel with winding 12.

Fig.2 and 3 show the transformer 10 is of the "pot-core" type. It comprises a bipartite housing 20 including hollow, coaxial, generally cylindrical sections 21 and 22, of ferrite or other material of high magnetic permeability, which contain windings 12 and 13 respectively.

Housing 21 comprises an end wall or base 23 from which a peripheral wall 24 extends to a rim 25, and from which a central pedestal 26 extends in the same direction; pedestal 26 ist traversed by an axial hole 27. Housing section 22 comprises an end wall or base 33 from which a peripheral wall 34 extends to a rim 35, and from which a central pedestal 36 extends in the same direction. Pedestal 36 is traversed by an axial hole 37.

Winding 12 is mounted in housing section 21 around its pedestal 26, and winding 13 is similarly mounted in housing section 22 about its pedestal 36.A suitable fastener 39 such as a nylon screw 40 passes through holes 27 and 37 to hold the sections in assembled relation with the rims and pedestals of the sections in opposition and contact, as shown in Fig.3.

A disc or washer 41 of ferrite or other suitable material is located in housing 20 between windings 12 and 13, to act as a magnetic shunt. For this purpose pedestal 36 may be provided with an accurately machined shoulder 42, and rims 25 and 35 may be machined to give cylindrical surfaces 43 accurately coaxial with shoulder 42. Disc 41 is circular in section with a circular central bore 45 to fit shoulder 42 with a minimum air gap, and with a periphery at 46 uniformly spaced from rims 43 by a predetermined radial air gap 47.

In the absence of disc 41 the flux generated by winding 12 is continuous in the high permeability material linking winding 13. The flux path is indicated by the arrows 61 in Fig.3.

When disc 41 is present, additional flux paths for winding12 exist, as shown by arrows 62; these paths are also in ferrite material except where they pass through air gap 47. This flux path does not link winding 13, and as a result has the same overall effect as would a series inductor 14 added, as shown in Fig.1.To a first approximation the inductance of that inductor is directly proportional to the product of the thickness of the disc multiplied by the perimeter of periphery 46, and is inversely proportional to the radial dimension of the gap; strictly speaking, a minimum air gap between bore 45 and shoulder 42 is unavoidable, and modifies the relation slightly, as do other paths between the disc and other parts of housing sections 21 and 22.

In a modification of the invention shown in Fig.4 , a shoulder 52 is machined in rim 25 and pedestals 36 and 26 are machined to give cylindrical surfaces 53 accurately coaxial with shoulder 52.

A disc 54 of ferrite material has a periphery 55, to engage shoulder 52 with a minimum air gap, and a central bore 56 coaxial therewith to provide an air gap of predetermined width with the pedestal surfaces. The same principal and shunt flux paths are present in this structure.

In a further modification of the invention shown in Fig.5, the housing portions are machined to have the concave

cylindrical surfaces 43 of Fig.3 and the convex cylindrical surfaces 53 of Fig.4 , thus providing both inner and outer radial air gaps with respect to disc 54, which is conveniently mounted with respect to the housing sections by suitable means not shown.

Reference should now be had to Fig.6 which shows the structure of Fig.3 with further modifications. Here, pedestal 26 is machined off so as not to contact pedestal 36, but to be spaced axially therefrom by an air gap 63, and has a shoulder 64 to receive a disc 65 of permeable material. The air gap 63 is in flux path 61, and functions as an inductor 15 (see Fig.1) in parallel with the transformer winding.

It occasionally happens that a series inductor is needed with a transformer having a plurality of secondary windings, which should have minimum interaction. Fig.7 and 8 show schematically how the desired result may be accomplished according to the present invention. Here, a housing 70 has sections 71 and 72 with central pedestal 73 and 74 on which are mounted a primary winding 75 and secondary windings 76 and 77. A ferrite disc 80 is mounted on pedestal 73 between winding 75 and 76, and has a radial outer air gap 81 with respect to housing section 71. A ferrite disc 82 is mounted on pedestal 74 between windings 75 and 77, and has a radial outer air gap 83 with respect to housing section 72.

The principal flux paths in this embodiment of the invention are suggested by the arrow 84 an the right of the figure, and links the primary winding 75. A secondary flux path is indicated by arrow 85 at the left of the figure, and links primary winding 75 but not secondary windings 76, while another secondary flux

path is suggested by arrow 86 and links primary winding 75 but not secondary winding 77.

The circuit equivalent of the structure is shown in Fig.9, in which effective inductances 89 and 90 are shown in series with windings 76 and 77 respectively.

A further modification of the structure of Fig.7 is shown in Fig.8. Here, pedestal 73 and 74 are cut away so that they do not engage each other. The flux paths are as shown in Fig.8, passing through the air gap between the pedestals. The circuit equivalent of the structure is shown in Fig.10, where a further effective inductance 91 is shown in parallel with winding 75.

It is understood that the various standard techniques for forming the windings on suitable bobbins, with Faraday shields, if desires, mounting them in the housing sections, and again with Faraday shields, if desired, bringing out electrical connections, and varnish dipping or encapsulating may be applied to these structures.

While the insertion of ferrite discs may slightly increase one dimension of the unit, it avoids the need to provide and mount a separate inductance component.

From the above it will be evident that the invention comprises a means providing magnetic shunt paths in transformers to modify the leakage fluxes in such a fashion as to function as independent inductance units in series or in parallel with transformer windings.

Claims:

1. Pot core transformer (10) comprising a housing (20) of high permeability material including first and second hollow sections (21,22) each having a base (23, 33), a peripheral wall (24,34) extending from said base to a rim (25,35) and a pedestal (26,36) extending from said base within said wall with said rims and said pedestals being in opposition and at least said rims being in engagement and further comprising windings (12, 13) mounting on said sections around said pedestal, characterized by a flat member (41) of high permeability and of predetermined thickness positioned between two of said windings and having a central bore (45) opposed to said pedestals (26,36) and a periphery (46) opposed to said rims (25,35).

2. Pot core transformer (10) comprising a housing (20) of high permeability material including first and second hollow sections (21,22) each having a base (23,33), a peripheral wall (24,34) extending from said base to a rim (25,35), and a pedestal (26,36) extending from said base within said wall with said rims and said pedestals being in opposition and at least said rims being in engagement and further comprising windings (12,13) mounting on said sections around said pedestal, characterized in that said pedestals (26,36) form an air gap (63) between them.

3. Transformer according to claim 1, characterized by flat members (80,82) between a first winding (75) and each of two other windings (76,77).

4. Transformer according to claim 1 or 3, characterized in that said pedestals (26,36) are in engagement.

5. Transformer according to claim 1, c h a r a c t e r - i z e d i n t h a t said member (41) is in engagement with said pedestal (26,36) and said rims (25, 35).

6. Transformer according to claim 1, c h a r a c t e r - i z e d in t h a t said member (41) is in engagement with one of said pedestals (26,36) and said rims (25,35).

7. Transformer according to claim 1, c h a r a c t e r - i z e d in t h a t said member (41) is spaced from said rims (25,35).

8. Transformer according to claim 1, c h a r a c t e r - i z e d i n t h a t said member (41) is spaced from said pedestals (26,36).

9. Transformer according to claim 1, c h a r a c t e r - i z e d i n t h a t said member (41) is spaced from said rims (25,35) and said pedestals (26,36).

10. Transformer according to claim 1 or one of the dependent sub-claims, c h a r a c t e r i z e d i n t h a t said pedestals (26,36) form an air gap (63) between them.

FIG. 1

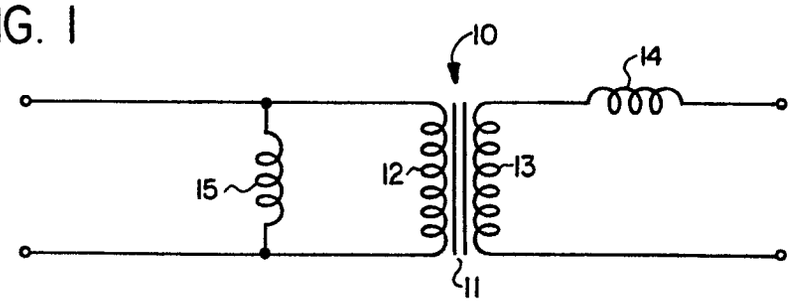

FIG. 2

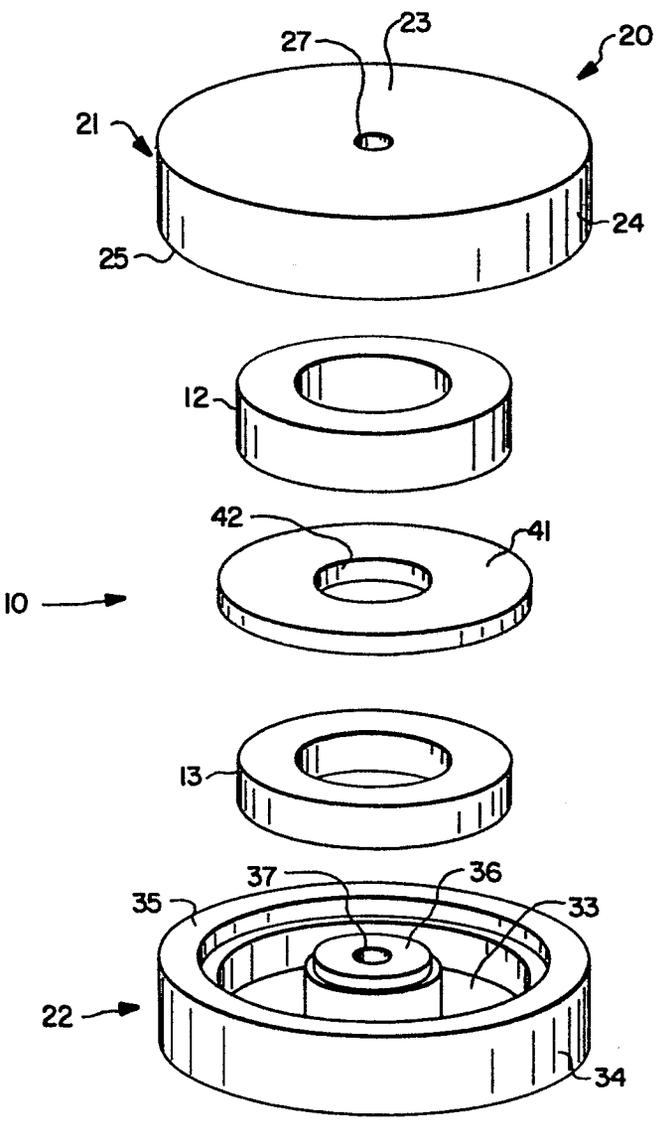

FIG. 3

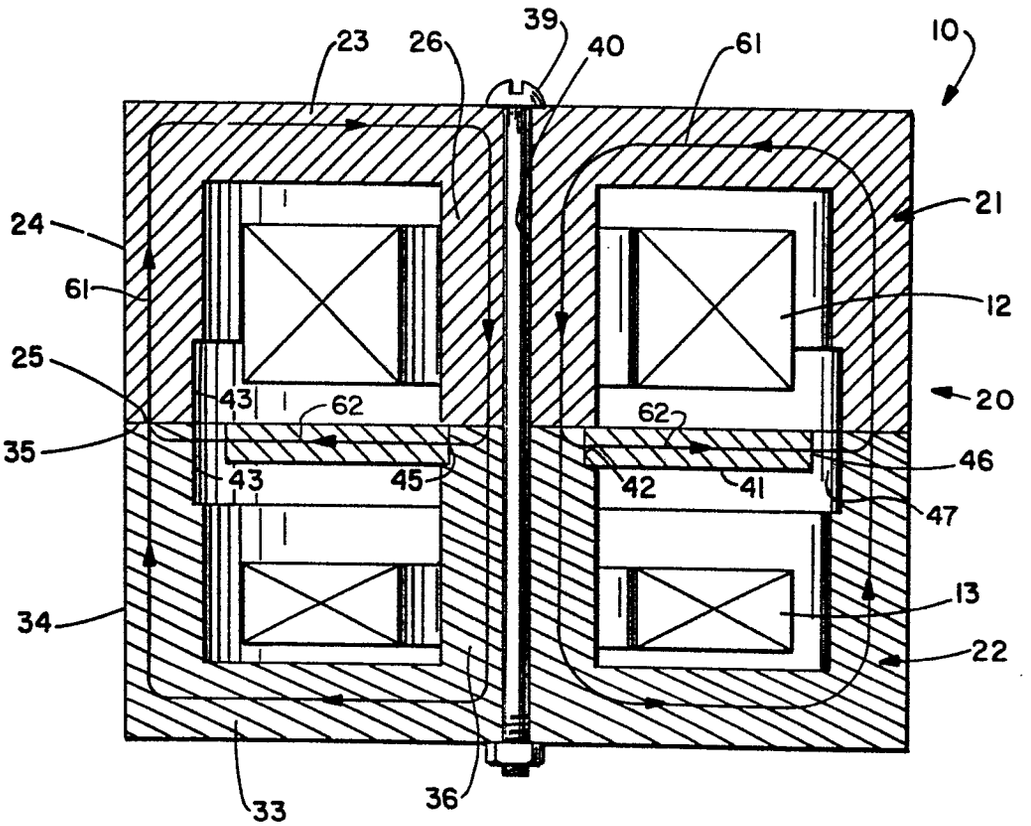
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FIG. 4

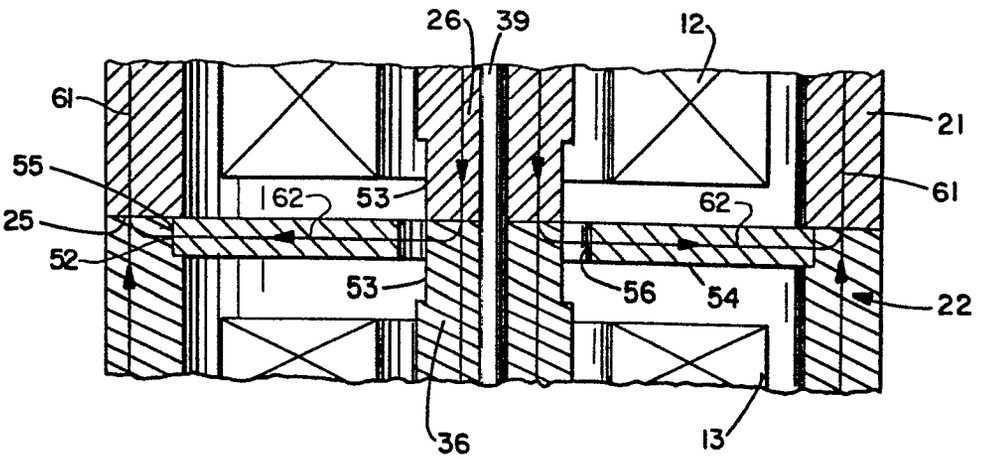
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FIG. 5

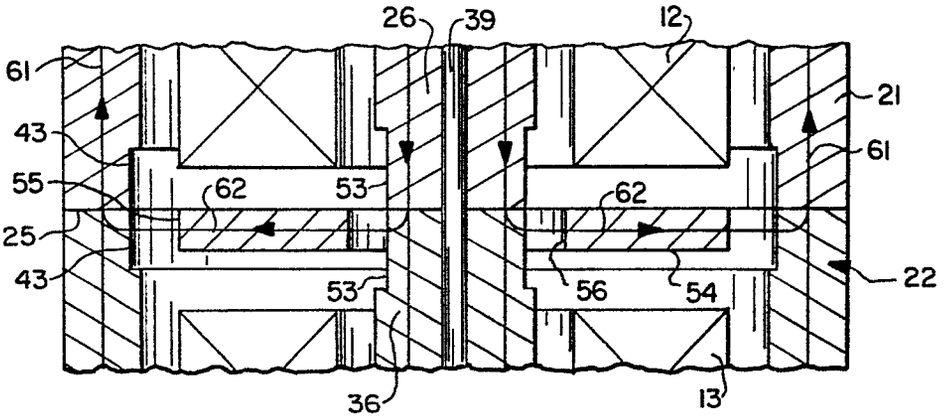


FIG. 6

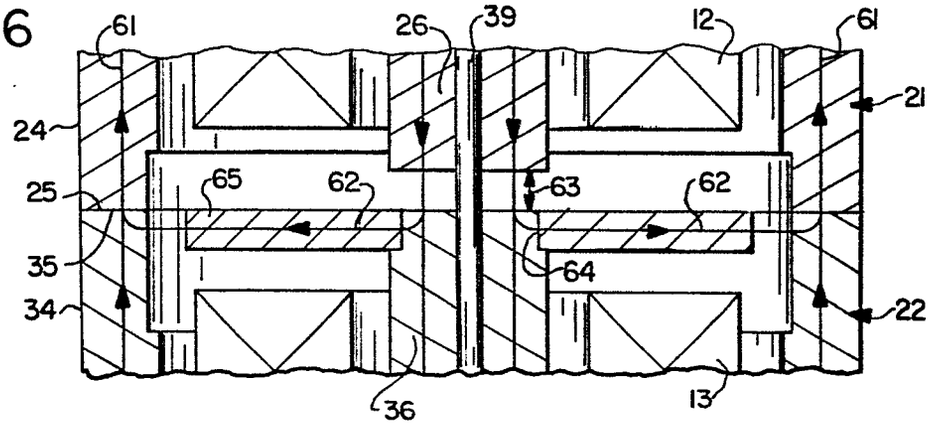


FIG. 7

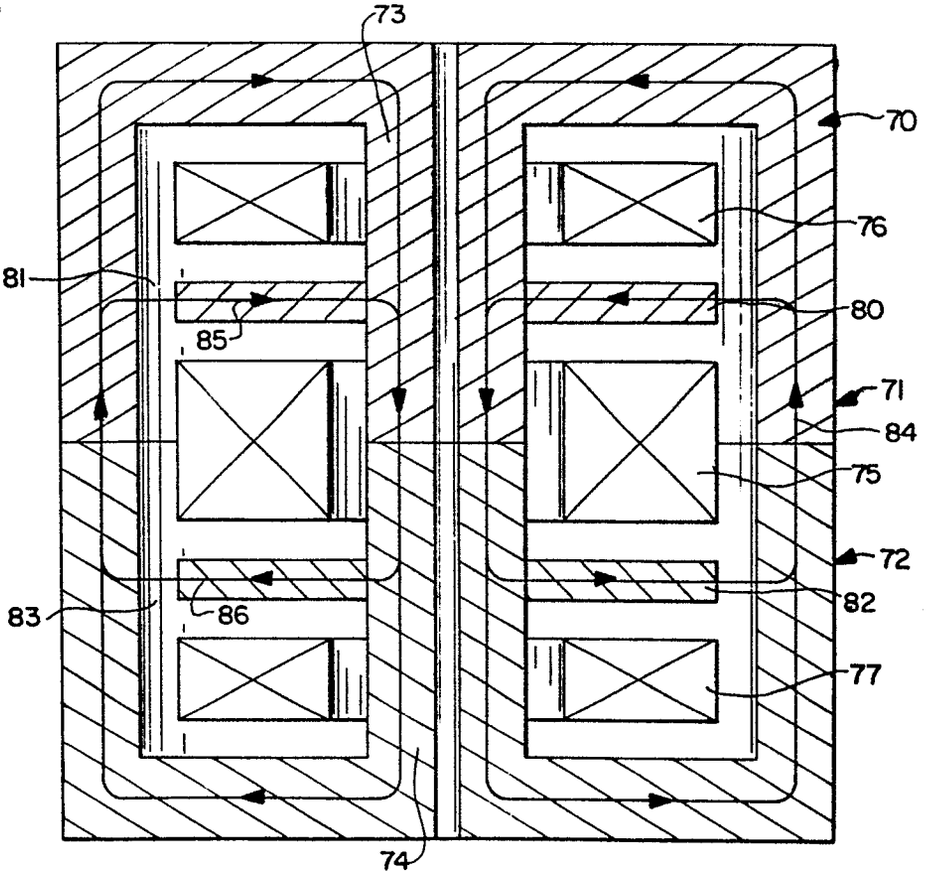


FIG. 9

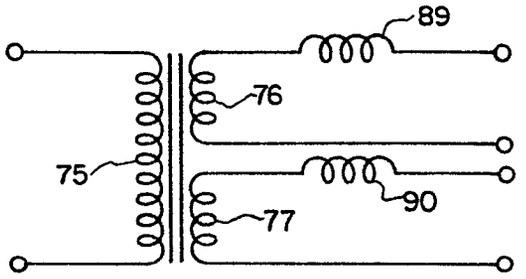


FIG. 8

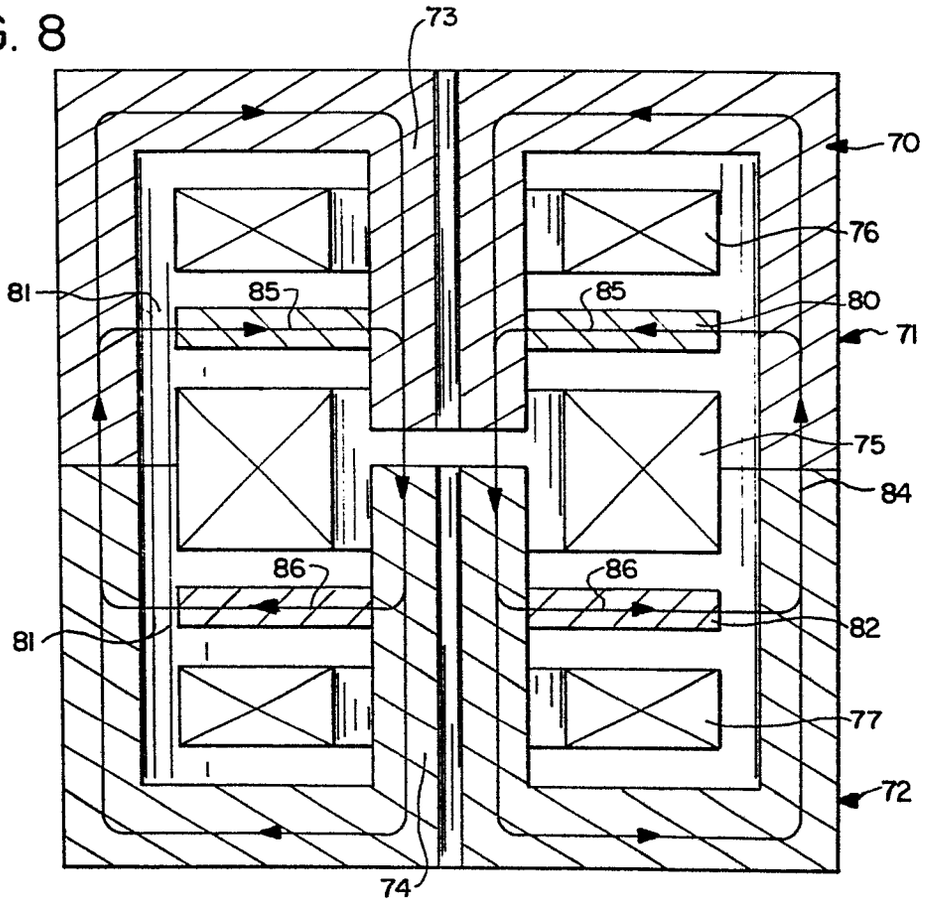
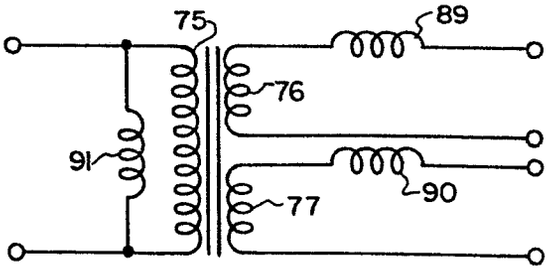


FIG. 10



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Application number

EP 83 10 9299

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	DE-A-1 439 441 (TELECOMUNICAZIONI SIEMENS) * Figure 1 *	1	H 01 F 17/04 H 01 F 31/06
X	* page 4, lines 12-14; figure 1 *	2,10	
Y	FR-A- 995 846 (THOMSON-HOUSTON) * Page 1, column 2, lines 26-31; figure 2 *	1	
A	DE-A- 951 826 (SIXTUS, BACKNANG) * Page 2, lines 53-65 *	1	
A	GB-A- 957 152 (MINISTER OF AVIATION) * Page 2, lines 79-106; figure 2 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) H 01 F
A	FR-A- 797 868 (WIRZ) * Page 3, line 96 - page 4, line 3; figure 8 *	4-9	
A	US-A-3 673 491 (BAYCURA) * Column 3, lines 3-10; figure 4 *	4-9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16-12-1983	CIGOJ P.M.

CATEGORY OF CITED DOCUMENTS

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