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(11) Publication number:

0 547 678 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **92203837.7**(51) Int. Cl.⁵: **H01J 29/76**(22) Date of filing: **11.12.92**(30) Priority: **19.12.91 EP 91203355**(43) Date of publication of application:
23.06.93 Bulletin 93/25(84) Designated Contracting States:
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NL-5656 AA Eindhoven (NL)(54) **Cathode ray tube comprising a deflection system.**

(57) A display device comprising a cathode ray tube and a deflection system. The deflection system comprises a line deflection coil system and a field deflection coil system. The field deflection coil is wound from parallel windings (52a and 52b) which are electrically arranged in series. As a result, the natural frequency of the field deflection coil is increased. By virtue thereof, disturbing influences of the horizontal flyback on picture display ("ringing") are reduced.

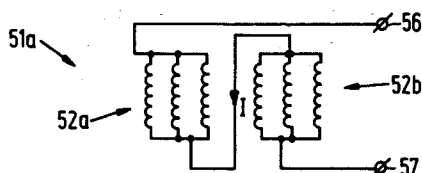


FIG.5
b

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The invention relates to a display device comprising

- a cathode ray tube having an electron gun and a display screen as well as
- a deflection system having a field and line deflection coil system.

Such display devices are used, *inter alia*, in black and white, colour and projection television receivers and in data display equipment.

A display device of the type mentioned in the opening paragraph is known.

In operation, the electron gun generates one or more electron beams. The deflection system generates electromagnetic fields for deflecting the electron beam (or electron beams) across the display screen in two directions which are approximately perpendicular to one another. Said directions are customarily referred to as the line direction, in which direction the display screen is scanned with a relatively high frequency, and as the field direction, in which direction the display screen is scanned with a relatively low frequency. During deflecting the electron beam(s), a phenomenon occurs which is hereinafter referred to as "ringing". A sudden change of the magnetic deflection field generated by the line deflection coil system brings about an excitation of the field deflection coil system. This phenomenon occurs, in particular, during the flyback of the line deflection and causes a deviation in the field deflection direction on a line written in the line deflection direction. This deviation is visible, in particular, in an area near the edge of the display screen, *i.e.*, at the location where horizontal scanning of the display screen starts.

This problem can be reduced by means of a known measure which is commonly referred to as an overscan of the display screen. An overscan of the display screen means that line scanning starts off the display screen. This does not reduce ringing but the consequences of this phenomenon are less visible or invisible on the display screen. The disadvantage of this measure is that the rate at which information is displayed on the display screen is reduced and that the electron beam has to be deflected through a larger angle, requiring a larger energy supply to the deflection system.

It is an object of the invention to reduce "ringing" in a display device of the type mentioned in the opening paragraph, in such a manner that the above-mentioned disadvantages do not occur.

To this end, a display device according to the invention is characterized in that the field deflection coil system comprises a deflection coil which is wound from a number of parallel conductor wires, which conductor wires are electrically arranged in series in such a manner that the direction of the conductor in the conductor wires is the same.

The conductor wires are wound parallel to each other. The expression "wound parallel to each other" is to be understood to mean within the framework of the invention, that the conductor wires are wound such that the conductor wires extend parallel to each other throughout the length of said conductor wires. The conductor wires are electrically arranged in series in such a manner that the direction of the conductor in said wires is the same. That is, in the energized state the electric conductors in parallel portions of the conductor wires extend parallel to each other. As the direction of the conductor in the conductor wires is the same, each energized conductor wire generates an approximately Dual (both in strength and in polarity) electromagnetic field. The total electromagnetic field is the sum of the electromagnetic fields generated by the individual conductor wires. The term "conductor wire" is to be understood to mean within the framework of the invention, both a single conductor wire and a multifilar conductor wire. The invention is *inter alia* based on the insight that, relative to a comparable field deflection coil wound from a single conductor wire, the field deflection coil which is suitable for a display device according to the invention has a higher natural frequency, as will be explained in more detail in the description of the drawings, and that, as a result, upon line flyback the excitation of the field deflection coil system is visible in a smaller area of the display screen and, besides, can be damped more rapidly. By virtue thereof, the distortion of a displayed image by "ringing" is reduced.

An embodiment of the display device according to the invention is characterized in that the field deflection coil is wound from two series-arranged, parallel conductor wires.

In this embodiment, the conductor wires are wound in pairs. This is a simple embodiment of the display device according to the invention.

An alternative embodiment of the display device according to the invention is characterized in that the field deflection coil is wound from more than two series-arranged, parallel conductor wires.

The advantage of the latter embodiment relative to the embodiment comprising two series-arranged, parallel-wound conductor wires is that the natural frequency is increased further, resulting in a reduction of "ringing". The disadvantage is that more interconnections have to be made.

An embodiment of the display device according to the invention is characterized in that each conductor wire is a multifilar conductor wire.

A multifilar conductor wire comprises more than one conductor wire, which conductor wires are arranged in parallel.

In an embodiment of the display device according to the invention, the conductor wires are

individually visually distinguishable.

After winding the conductor wires, said wires are interconnected. Conductor wires which are visually distinguishable simplify the interconnecting operation.

The invention also relates to a deflection system for a display device.

A description is given of a few exemplary embodiments of the display device according to the invention, with reference to the accompanying drawings, in which

Fig. 1 is a partly cut-away perspective view of a display device according to the invention;

Fig. 2 is a sectional view of a detail of a display device according to the invention;

Fig. 3 is a front view of a display screen;

Fig. 4a graphically shows the voltage across the field deflection coil immediately after the horizontal flyback;

Fig. 4b is a front view of a display screen;

Fig. 5a is a winding diagram of a known field deflection coil;

Fig. 5b is a winding diagram of a field deflection coil according to the invention;

Fig. 5c is a winding diagram of a further example of a field deflection coil according to the invention.

Fig. 6 graphically shows a comparison between voltages occurring in field deflection coils immediately after the horizontal flyback.

The Figures are diagrammatic and are not drawn to scale, corresponding parts in the different embodiments generally bearing the same reference numerals.

Fig. 1 is a partly cut-away perspective view of a display device according to the invention, for example a 110° monochrome monitor. The invention can also be used in colour monitors and television receivers. The display device comprises a cathode ray tube having a glass envelope 1 which is made up of a display window 2, a cone 3 and a neck 4. In the neck 4, there is provided an electron gun 5 for generating an electron beam 6. Within the scope of the invention, the term "electron gun" is to be understood to mean a means for generating one or more electron beams. The electron beam 6 is focused to form a target spot 8 on a display screen 7. Said display screen 7 is provided on the inside of the display window 2. The electron beam 6 is deflected across the display screen 7 in two mutually perpendicular directions x, y by means of a deflection system 9. The tube comprises a base 10 having connections 11. In the Figure, the x- and y-directions are indicated as well as the z-direction which extends perpendicularly to the x-direction and the y-direction.

Fig. 2 is a sectional view in the y-direction of an example of a deflection system 9. Said deflec-

tion system comprises a line deflection coil system 12 for deflecting the electron beam in the line deflection direction (the x-direction) and a field deflection coil system 13 for deflecting the electron beam in the field deflection direction (the y-direction). In this example, the line deflection coil system 12 comprises two saddle coils and the field deflection coil system 13 comprises one toroidal coil. A support 14 is arranged between the systems 12 and 13. The toroidal deflection coil is wound on a core 15. This example is not to be interpreted in a limiting sense, the deflection coil systems may be of the saddle type, the toroidal type or of another type.

The screen is scanned in a large number of lines in the line direction. Fig. 3 diagrammatically shows the scanning of the display screen. The deflection coil system 12 deflects the electron beam in the x-direction. Scanning is effected one line at a time, for example line 31. After line 31 has been scanned, the electron beam returns very rapidly to the beginning of the next line. This return of the electron beam is herein termed horizontal flyback. The field deflection coil system 13 deflects the electron beam in the y-direction. The horizontal flyback brings about an excitation in the field deflection coil system 13.

Figs. 4a and 4b diagrammatically show the effect of an excitation of the field deflection coil system. During the horizontal flyback the electromagnetic field generated by the line deflection coil system 12 changes in a very short time. Said change induces an excitation of the field deflection coil system 13. As a result, a voltage is induced in the field deflection coil system, causing a conductor to pass through the field deflection coil, which conductor generates an electromagnetic interference field which deflects the electron beam in the y-direction. In Fig. 4a, line 41 represents the voltage across the field deflection coil immediately after the horizontal flyback. In Fig. 4a the voltage V is plotted on the vertical axis and the time t in μ s is plotted on the horizontal axis, where t = 0 represents the moment of the horizontal flyback. Line 41 exhibits an approximately sinusoidal deviation at the beginning of the line, i.e. immediately after the horizontal flyback. Fig. 4b shows the effect of the voltage induced in the field deflection coil system. A deviation occurs at the beginning of the line 42 written in the line direction, which deviation extends transversely to the line direction. This disturbance is invisible if the deflection of the electron beam immediately after the horizontal flyback is such that the electron beam is deflected beyond the display screen. In this case, the visible part of the display screen starts, for example, at dotted line 43. However, this reduces the velocity with which information can be displayed on the screen, since there is

a period of time during which the electron beam does not scan the display screen, and, besides, it requires an additional energy supply. In general, the part of line 42 having a visible sinusoidal deviation increases with the line frequency. In the case of HDTV (High Definition TeleVision) and monitors having a high resolution, the aim is to increase the line frequency.

It is an object of the invention to provide a cathode ray tube in which "ringing" of the field deflection coil system is reduced.

Fig. 5a shows a winding diagram for a known field deflection coil. The coil 51 comprises a multifilar conductor wire 52 which consists of three parallel-arranged conductor wires 53, 54 and 55 having n turns, for example approximately 1000 turns. In operation, a conductor I is passed through the deflection coil to generate an electromagnetic field for deflecting the electron beam(s) in the field deflection direction, hereinafter termed vertical deflection field. The total resistance of the field deflection coil is R . In operation, an alternating voltage is applied to the electric connections 56 and 57.

Fig. 5b shows a winding diagram for a field deflection coil 51a according to the invention. In this example, the deflection coil 51a comprises multifilar conductor wires 52a and 52b which are wound in parallel. Hereinbelow, a field deflection coil according to the invention will be compared with a field deflection coil wound according to the diagram shown in Fig. 5a. Each of the conductor wires 52a and 52b has $n/2$, in this example 500, turns. The length of the conductor wires 52a and 52b is half the length of conductor wire 52. The beginning of the conductor wire 52a is connected to the end of the conductor wire 52b. Thus, the direction of flow of the conductor I in the conductor wires 52 and 52b is the same. The resistance of the deflection coil is equal to the resistance of the deflection coil shown in Fig. 5a, i.e.:

$$\frac{1}{2}R \text{ (for conductor wire 52a)} + \frac{1}{2}R \text{ (for conductor wire 52b)} = R.$$

When a conductor I is passed through the conductor wires 52a and 52b, the electromagnetic field generated by the deflection coil is equal to the sum of the electromagnetic fields generated by the conductor I in each of the conductor wires. As the conductor wires 52a and 52b are wound in parallel and arranged in series such that the direction of flow in the conductor wires is the same, the conductor wires generate electromagnetic fields of equal strength and polarity. The coils 51 and 51a, whose winding diagram is shown in Figs. 3a and 3b, generate approximately equal electromagnetic fields if said coils 51 and 51a are energized with

equal deflection voltages. Consequently, as regards the generation of a field for deflecting the electron beam (5), coils 51 and 51a do not or hardly differ from each other. The difference between the coils 51 and 51a resides in the fact that the self-induction of coil 51a is approximately one-fourth of the self-induction of coil 51. Consequently, the natural frequency of coil 51a is twice that of coil 51. The excitation of the field deflection coil (51, 51a) caused by the horizontal flyback has a frequency which is equal to the natural frequency of this coil. The effect of the increase of the natural frequency of coil 51a relative to coil 51 is shown in Fig. 6. In Fig. 6, line 61 shows the voltage induced by the horizontal flyback in a field deflection coil which is wound from one conductor wire 51 having three parallel-arranged conductor wires (coil 51) and line 62 shows the voltage induced in a coil having two parallel-wound, series-arranged conductor wires 51b, 51c (coil 51a). The frequency of the voltage induced in coil 51a is approximately twice the frequency of the voltage induced in coil 51. Consequently, ringing is confined to a smaller area of the display screen. Damping of an induced voltage having a natural frequency increases as the natural frequency increases, i.e. damping is approximately proportional to the square of the natural frequency. Thus, the induced voltage is damped more rapidly in coil 51a than in coil 51. As a result thereof, ringing is also less visible.

Ringing can be reduced even further if the field deflection coil comprises more than two parallel-wound, electrically series-arranged conductor wires. The natural frequency of the field deflection coil increases as the number of parallel-wound conductor wires increases. An increase of the natural frequency has a favourable effect on ringing. However, more interconnections have to be made. The winding diagram of a field deflection coil having three parallel-wound conductor wires 52c, 52d and 52e is shown in Fig. 5c. The number of turns is approximately $n/3$.

Preferably, the conductor wires (52a, 52b (Fig. 3b) or 52c, 52d, 52e (Fig. 3c)) are individually visually distinguishable. After the conductor wires are wound in parallel, they are interconnected in such a manner that they are electrically arranged in series. The conductor wires can be interconnected more easily if they are visually distinguishable, for example if they have different colours.

It will be obvious that within the scope of the invention many variations are possible to those skilled in the art.

For example, the conductor wires may comprise a single conductor wire or a plurality of electrically parallel-arranged conductor wires, as shown in Figs. 5b and 5c. In the above example, the line deflection direction is the horizontal direction (x -

direction). Alternatively, the line deflection direction may be the vertical direction.

Claims

1. A display device comprising a cathode ray tube having an electron gun and a display screen as well as a deflection system having a field and a line deflection coil system, characterized in that the field deflection coil system comprises a deflection coil which is wound from a number of parallel conductor wires, which conductor wires are electrically arranged in series in such a manner that the direction of the conductor in the conductor wires is the same.

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2. A display device as claimed in Claim 1, characterized in that the field deflection coil is wound from two series-arranged, parallel conductor wires.

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3. A display device as claimed in Claim 1, characterized in that the field deflection coil is wound from more than two series-arranged, parallel conductor wires.

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4. A display device as claimed in Claim 1, 2 or 3, characterized in that each conductor wire is a multifilar conductor wire.

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5. A display device as claimed in one of the preceding Claims, characterized in that the conductor wires are individually visually distinguishable.

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6. A deflection system which is suitable for a display device as claimed in any one of the preceding Claims.

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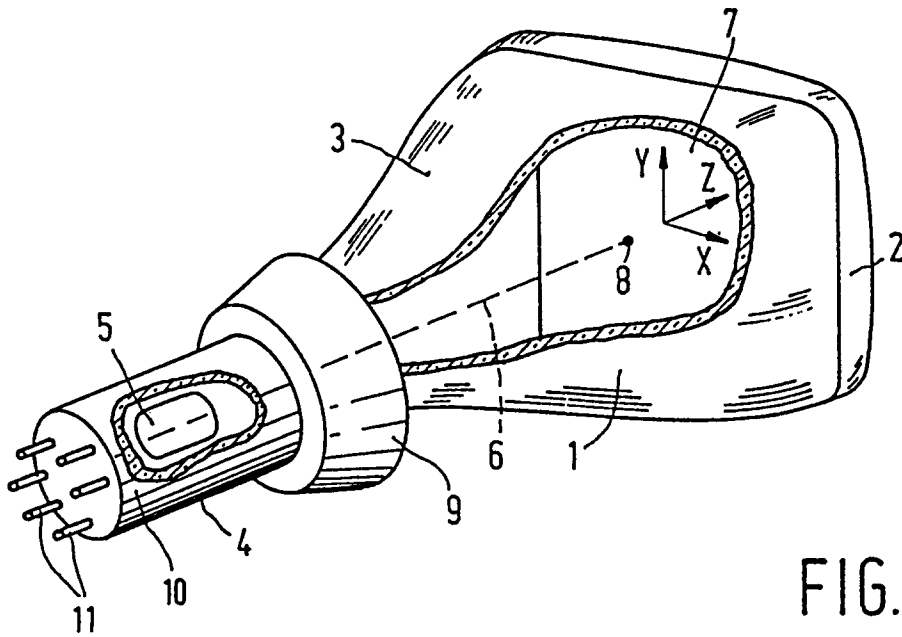


FIG. 1

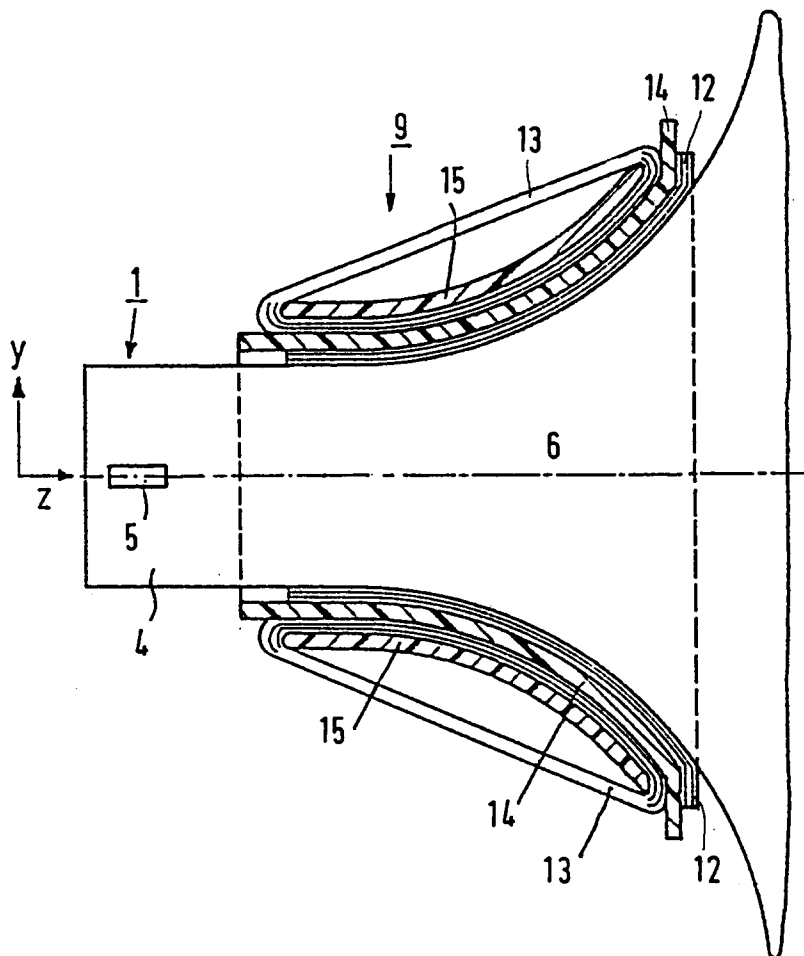


FIG. 2

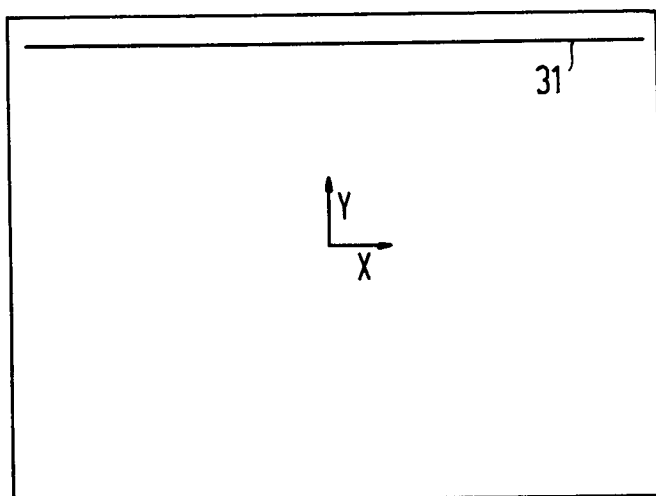
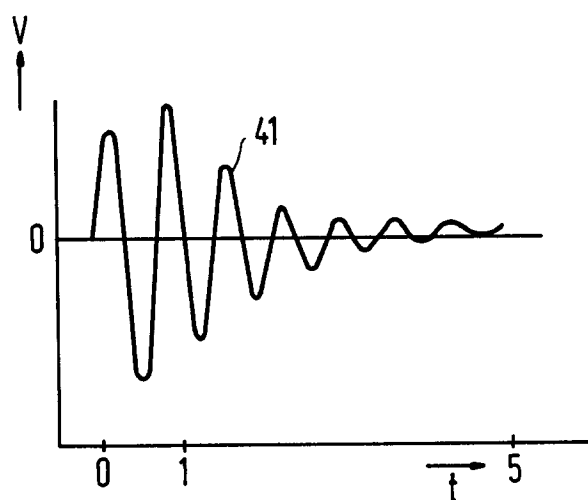
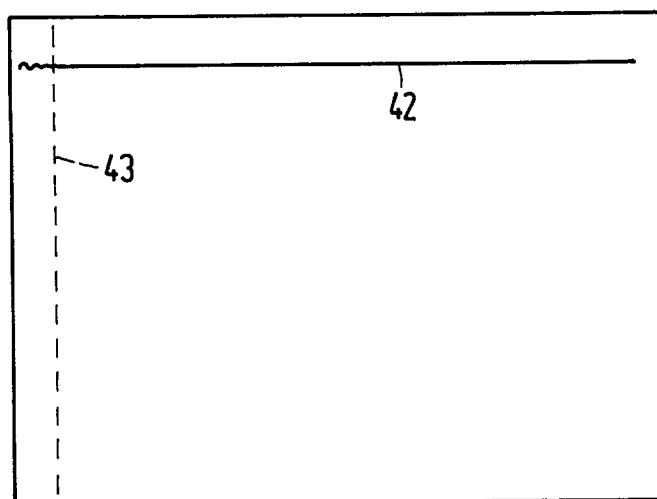


FIG. 3

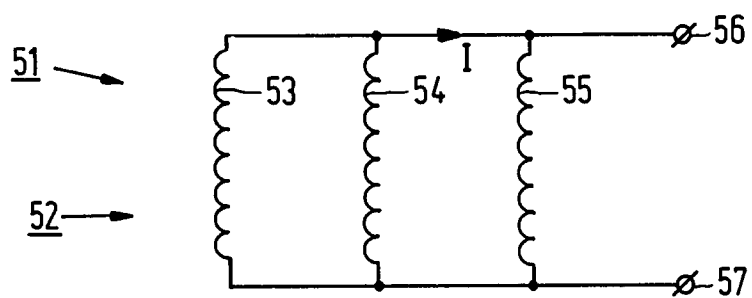


a

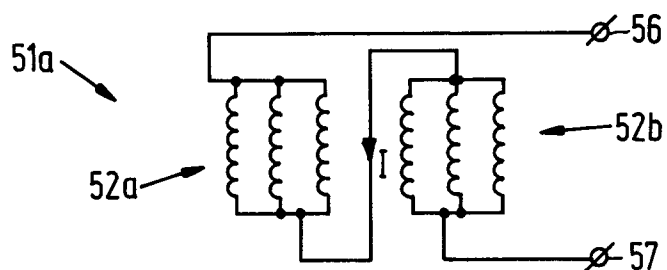


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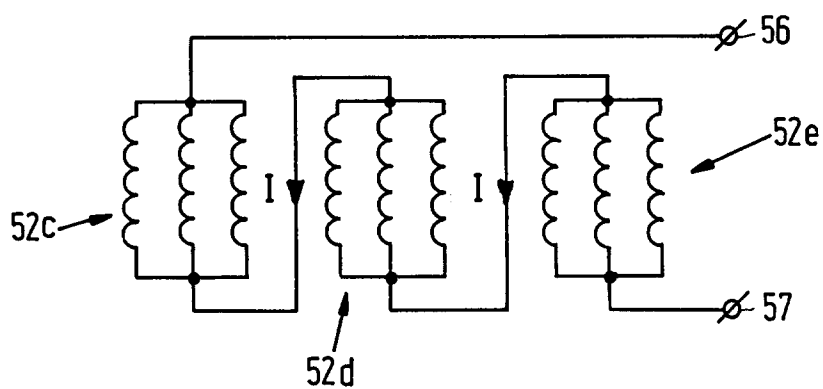
FIG. 4



a



b



c

FIG.5

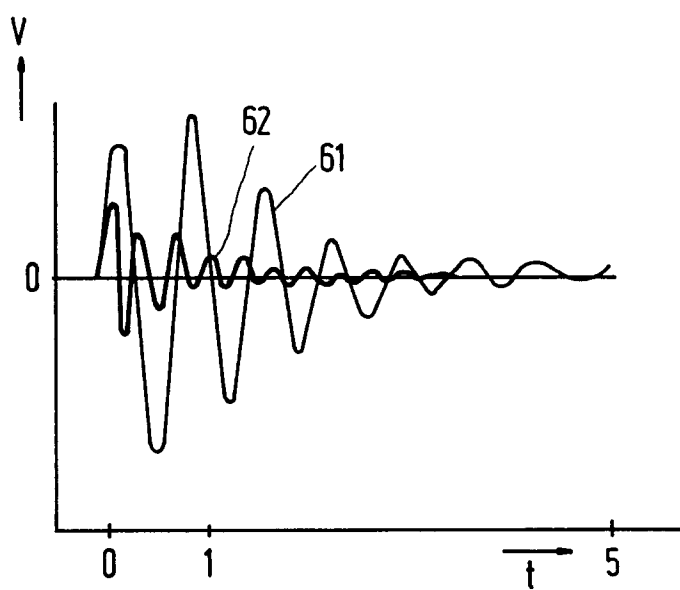


FIG.6



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EUROPEAN SEARCH REPORT

Application Number

EP 92 20 3837

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.5)
X	US-A-2 799 798 (KRATZ ET AL.) * column 1, line 70 - column 2, line 3 * * column 2, line 62 - column 3, line 15 * * column 4, line 4 - line 9 * * column 4, line 50 - line 55 * * claims; figure 5 *	1-4,6	H01J29/76
A	EP-A-0 198 535 (NV. PHILIPS' GLOEILAMPENFABRIEKEN) * abstract; figures * * page 1, line 29 - page 2, line 11 * -----	4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H01J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 FEBRUARY 1993	Examiner COLVIN G.G.
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