

[54] APPARATUS FOR TREATING HAIR UTILIZING DIELECTRIC LOSSES

[75] Inventors: **Georges Boudouris**, Grenoble;
Gregoire Kalopissis; **Jean-Luc**
Levesque; **Paul Roussopoulos**, all
of Paris, France

[73] Assignee: **L'Oreal**, Paris, France

[22] Filed: **Dec. 20, 1971**

[21] Appl. No.: **209,696**

[52] U.S. Cl. **219/222**, 132/7, 132/33 R,
219/10.49

[51] Int. Cl. **A45d 2/36**, H05b 9/06

[58] Field of Search.....219/222-6, 10.49;
132/7, 33 R

[56]

References Cited

UNITED STATES PATENTS

1,892,106	12/1932	Jancke	219/222 X
2,118,594	5/1938	Douden	219/222 X
2,137,189	11/1938	Whitman	219/222 X
3,019,795	2/1962	Weatherholt et al.	219/222 X

Primary Examiner—**R. F. Staubly**

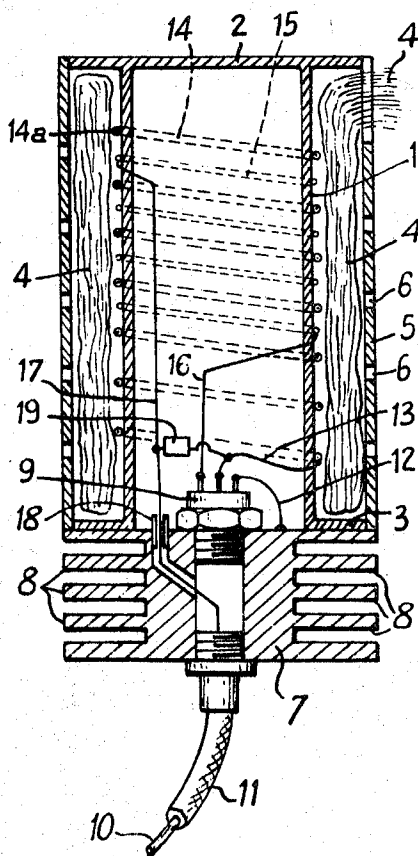
Attorney—**Joseph F. Brisebois et al.**

[57]

ABSTRACT

Device for treating hair by dielectric losses in which most of the high frequency current utilized is generated within or closely adjacent an electromagnetically closed jacket which holds the hair to be treated.

6 Claims, 5 Drawing Figures



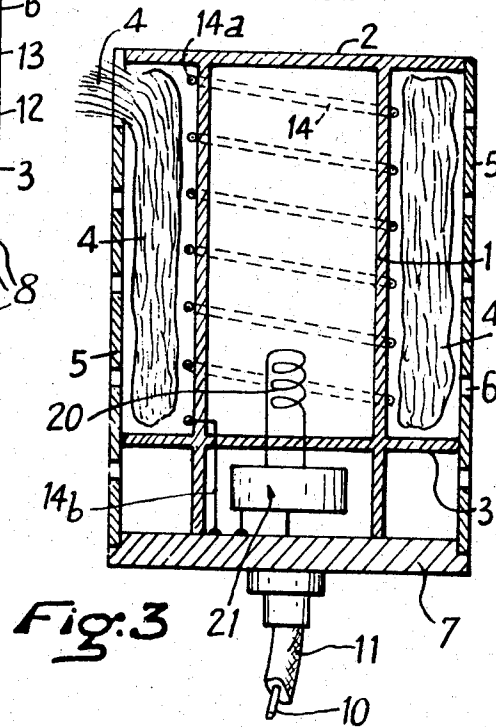
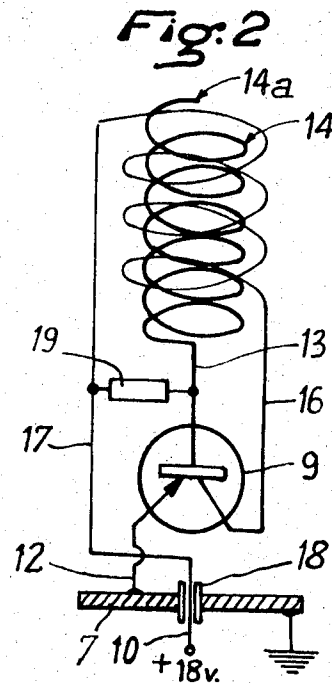
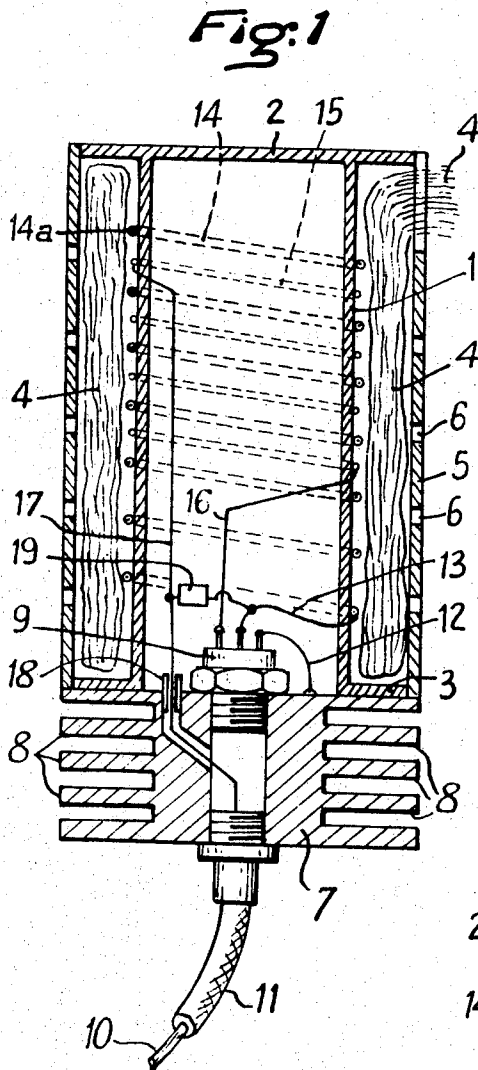


Fig. 4

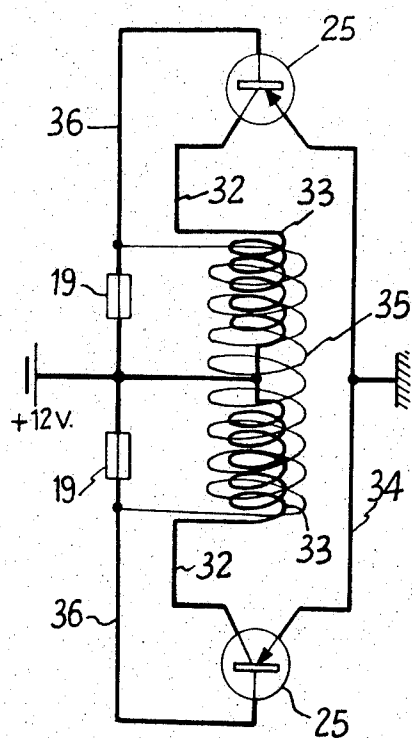
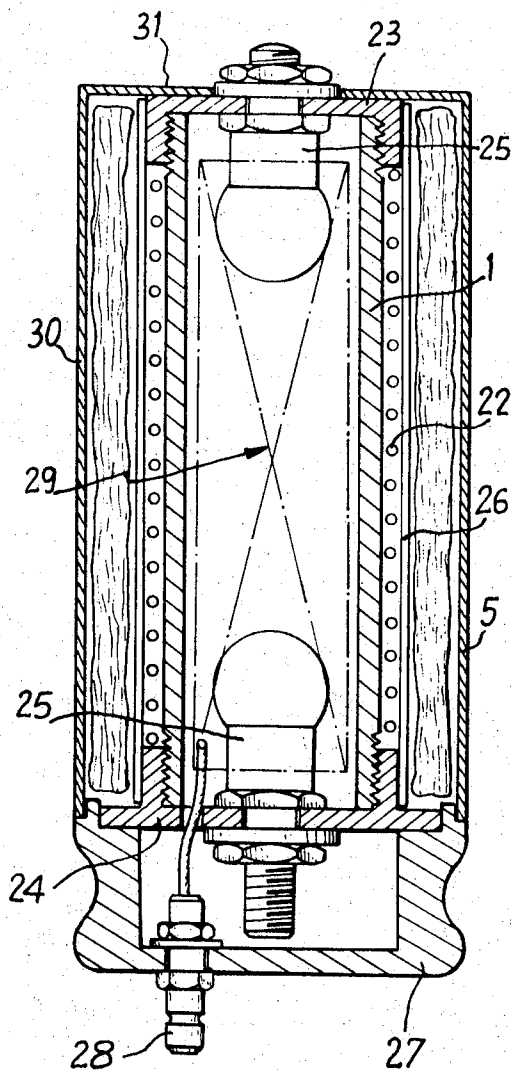


Fig. 5



APPARATUS FOR TREATING HAIR UTILIZING DIELECTRIC LOSSES

SUMMARY OF THE INVENTION

This invention relates to new devices for treating hair by dielectric losses.

It has already been suggested that a process be provided which utilizes high frequency electromagnetic fields which make it possible to increase the temperature inside the hair so as to accelerate any chemical reactions which may be produced, to provide a particularly intense and profound drying of the hair, and even to plastify the keratinic fiber by a simple increase in temperature.

One specific process which has already been described treats the hair by subjecting it to the action of a high frequency electromagnetic field and is characterized by the fact that the hair to be treated is placed inside a resonator which is impedance matched to a generator and high frequency transmission line.

The present invention relates to new devices which are also adapted to treat hair by subjecting it to the action of a high frequency electromagnetic field, in which the hair is placed in a resonator inside which, or immediately adjacent which, most or all of the necessary high frequency energy is produced.

The resonators according to the present invention may be characterized as comprising:

a. a closed outer jacket (in the electromagnetic sense of the term), which is preferably grounded. By "closed jacket" is meant an electrically conductive jacket having a closed surface or a substantially closed surface the openings in which have dimensions so small that they do not permit the escape of a substantial quantity of electromagnetic energy from inside the jacket;

b. a coupling member through which the high frequency electromagnetic energy is radiated inside the jacket. In accordance with a first embodiment of the invention, the resonator comprises inside its jacket a high frequency generating system which utilizes the coupling member as a constituent part of its oscillating circuit.

In this way, the volume inside the jacket of the resonator is the locus of high frequency electromagnetic energy, the frequency of which corresponds to the resonant frequency of the resonator because the latter determines the frequency of the circuit engendered by the generator system inside the jacket.

It follows that the generator functions necessarily at the resonant frequency of the resonator-receiver, thus insuring self-adaptation despite variations in the state of the hair inside the jacket.

As has been explained in our application Ser. No. 196,122, to the extent that the hair dries, the resonant frequency of the resonator changes, which leads to a change in the frequency the high frequency electromagnetic field should possess in order to continue to be perfectly matched to the resonator.

Moreover, the devices which have just been described have the peculiarity of producing a high frequency electromagnetic field inside an electromagnetically closed jacket utilizing a relatively small power so that there is practically no electromagnetic radiation outside the device, thereby satisfying the international regulations relating to radiation regardless of the actual frequency of the electromagnetic field.

In a particular embodiment, the generator of the high frequency electromagnetic field comprises a transistor, the base of which is connected to a first coil, the other end of which may be free, and the collector of which is connected to a source of DC current through a second coil coaxial with the first mentioned coil and supplied through a filter capacitor, the emitter of the transistor being connected to ground and the base being connected through a resistance to the positive terminal of the DC source.

In this embodiment, it is advantageous to wind the hair about the two concentric electrical coils which have just been described and to cover the assembly with an electromagnetically closed jacket, said jacket consisting for example of a metallic wall, of aluminum for instance, pierced by suitable orifices to permit aeration of the hair.

In this embodiment, it is also advantageous to place the transistor on a metal base provided with cooling vanes so as to effectively cool the transistor.

The electrical coils may advantageously be mounted in an insulating material, in particular a synthetic material, such as polytetrafluorethylene, which is known for its good resistance to high temperatures.

The device which has just been described has the advantage that it may be supplied by a flexible conductor having a small cross-section which transmits only direct current and consequently produces no radiation.

When the different characteristics of the assembly comprising the resonator and the high frequency generator system which have just been described are correctly determined, it is only necessary to supply direct current to the collector in order to initiate oscillations which are self-sustaining and produce the high frequency electromagnetic field.

In one improved embodiment it is possible to initiate the electromagnetic oscillations by supplying through the DC conductor oscillations or successive voltage increases of very short duration which have the effect of triggering electromagnetic oscillations inside the resonator.

In a second embodiment of the device according to the invention a high frequency current generator which directly supplies the resonator is mounted inside the resonator, preferably in a compartment thereof.

In this embodiment the generator and the resonator proper are enclosed in the same electromagnetically closed jacket so that the high frequency electromagnetic energy is produced in the same place in which it is used.

In this embodiment, electrical energy is supplied to the device through a conventional flexible conductor which transmits only a very small DC current.

In this case as well, since the generator of high frequency energy is of low power and is inside an electromagnetically closed jacket, any desired frequency may be used without risking radiation and contravention of the international rules relative to communications systems.

Of course, in this embodiment of the invention the frequency of the electromagnetic energy produced by the generator corresponds to the resonant frequency of the resonator.

To couple the high frequency electromagnetic energy produced by the generator and the resonator various devices which have been described in application Ser. No. 196,122 may be used.

In a third embodiment of the device according to the invention, a power amplifier for high frequency current which supplies the coupling means which distributes the electromagnetic energy inside the jacket may be placed inside the resonator as has already been explained.

In this embodiment, the supply conductor is a coaxial cable which conducts to the device a low power high frequency current as well as the direct current necessary to operate the amplifier.

In this embodiment as well, the characteristics of the high frequency current should be selected so that it is matched to the resonant frequency of resonator.

It is possible to use, in connection with a plurality of devices according to the last described embodiment, a single high frequency generator which simultaneously supplies the different devices by delivering to each a relatively low power, which power is amplified by the amplifier inside the jacket of the resonator. The frequency of the electromagnetic energy which may be used in accordance with the invention may vary within broad limits. It may range for example from several tens of megacycles to several tens of thousands of megacycles. In accordance with the invention it is possible to modify the frequency resonator by modifying its shape as well as the relative positions of the components which it contains. It is also possible to modify the shape, nature, and dimensions of the electrical coils within the jacket. It is even possible to introduce dielectric materials into the resonator.

In order that the invention may be more clearly understood, several embodiments thereof will now be described, purely by way of illustration and example, with reference to accompanying drawings, in which:

FIG. 1 is a schematic sectional view showing a device according to the first embodiment of the invention;

FIG. 2 is a circuit diagram showing the electrical circuit of the embodiment of FIG. 1;

FIG. 3 is a schematic sectional view showing second and third embodiments of the invention;

FIG. 4 is a circuit diagram of a fourth embodiment and;

FIG. 5 is a sectional view through a roller according to a fourth embodiment of the invention.

FIG. 1 shows a core 1 made of insulating material, for example of polytetrafluoroethylene, which core is cylindrical in shape and provided at one end with an end plate 2 which is electrically conductive and at its other end with an annular end plate 3.

The core 1 and the end plates 2 and 3 define a sort of spool on which the lock of hair schematically represented at 4 may be wound.

A removable cylinder 5 is pierced by orifices 6 may be positioned around the core 1 over the end plates 2 and 3 so as to define with the end plate 2 and the metallic base 7 an electromagnetically closed jacket which prevents the diffusion of high frequency radiation outwardly of the device.

The base 7 is provided with vanes 8 for dissipating the heat from the vicinity of the transistor 9, which is mounted on the metallic base 7 by any suitable means.

A conductor 10 in a conductive sheath 11 enters through the lower end of the base 7.

A wire 12 connects the base 7 to the emitter of the transistor 9, the base of which is connected by the wire 13 to a coil 14, the end 14a of which is free, that is to say, not connected to any other point.

A second coil 15 in coaxial with the coil 14 has its end 16 connected to the collector of the transistor 9 and its end 17 connected to the conductor 10 through a coaxial filtering capacitance 18. Finally, the base of the transistor is connected to the conductor 17 by a resistance 19.

The circuit diagram of FIG. 2 shows the different electrical components which have been described, conductor 10 being connected to an eighteen volt DC source, for example, and the base 7 being connected to ground.

The transistor 9 is of the NPN type and may be, for example, one sold under No. 2 N3926 by MOTOROLA.

The coil 14 has eighteen turns of wire 0.6 mm in diameter extending over a total length of 36 mm. The cylinder 1 supporting the coils has a diameter of 54 mm. The coil 15 has eight turns of wire 0.4 mm in diameter extending along a cylinder 14 mm in diameter.

The resistance 19 has a value of 22 kilo-ohms. The capacitance 18 has a value of 2,200 picofarads. When using a cylindrical jacket 5 which is 28 mm in diameter and 65 mm long enclosing a large lock of hair as shown in FIG. 1, a frequency of about 65 megacycles is obtained.

FIG. 3 schematically shows the second and third embodiments of the invention.

This figure shows the core 1 and the two end members 2 and 3 which define the spool on which the hair 4 is wound as well as the cylinder 5 which defines with the base 7 and the end member 2, the resonator jacket.

It also shows the coil 14, the end 14a of which is free, while its other end 14b is connected to the base 7, which is in turn connected to ground.

In the embodiment illustrated, a coupling member 20 is positioned in the center of the resonator. According to the second embodiment of the invention the coupling member 20 is connected to a generator of high frequency electromagnetic energy 21 which may consist of any conventional type of low power high frequency generator. This generator of high frequency current 21 is supplied by the conductor 10 inside the sheath 11, which is itself grounded. It will thus be seen that, as a result of this arrangement, the electromagnetic energy necessary to treat the hair is generated entirely inside the electromagnetically closed jacket which constitutes the cavity of the resonator. In this manner it is possible to use whatever frequency may be desired, for there is no radiation leaving the resonator jacket.

This embodiment has the great advantage that it may be supplied by means of a simple wire carrying a low voltage direct current which presents no danger for the person whose hair is being treated or the person who is carrying out the treatment.

In the third embodiment of the invention, the generator of high frequency current 21 which is shown in FIG. 3 is replaced by a high frequency current amplifier. In this case, the conductive wire 10 is necessarily a coaxial cable and supplies the amplifier 21 with a high frequency current which is then amplified in the amplifier 21, which may be of any conventional type.

This embodiment makes it possible to supply over the coaxial cable 10 high frequency energy having a power of as much as 1 watt, for example, and amplify this power to a value of 5 or 10 watts in the amplifier 21.

On the other hand, this coaxial cable 10 must also carry the direct current necessary to operate the amplifier.

A single high frequency generator may be used with this embodiment to supply a plurality of devices such as those which have been described, since the high frequency electromagnetic energy is transmitted at low power, which is then amplified inside the jacket of the resonator. This avoids the difficulties inherent in the transmission of high frequency electromagnetic energy in coaxial conductors. It is known that the quality of such transmission decreases rapidly when high frequencies are used, for example several hundreds of thousands of megacycles.

In the two embodiments which have been described and are illustrated on FIG. 3 it is also clear that it is necessary to use electromagnetic energy having a frequency corresponding to the resonant frequency of the resonator. For this purpose it is possible to utilize various means which make it possible to modify or match the resonant frequency of the resonator, which means have been referred to above and are described in a detailed manner in application Ser. No. 196,122.

FIGS. 4 and 5 show a fourth embodiment of the invention similar to the one illustrated in FIGS. 1 and 2.

FIG. 5 is an axial sectional view through this embodiment showing a central cylindrical core 1 made of polytetrafluoroethylene, for example, which is adapted to support the coils schematically represented at 22 and the structure of which will be hereinafter described in greater detail.

The core 1 comprises the end members 23 and 24 screwed to its ends. These may be made of aluminum for example and serve as supports for two transistors 25. A cylindrical protective sheath 26 is positioned around the coil 22 and may also be made of polytetrafluoroethylene, for example.

At the extreme lower end, the end member 24 is fixed to a base 27 made of plastic material such as polyvinylchloride, the periphery of which base is provided with an annular groove to make it easier to grip.

The base 27 also supports the contact 28 on which the cable through which the DC current is supplied is mounted.

To simplify the drawing of FIG. 5 the electronic components of the roller which are located in the space 29 defined schematically by the phantom lines are not shown.

Finally, a cylindrical jacket 30 having an end member 31 and made of an electrically conductive material constitutes the jacket of the resonant cavity.

While not shown in FIG. 5, the jacket 30 is provided with orifices to permit dissipation of the vapor resulting from drying of the hair and to admit the lock of hair which is wound up on the core of the roller until the jacket 30 has been brought close to the head of the person undergoing treatment. FIG. 4 shows the circuit diagram of the roller of FIG. 5.

This diagram is symmetrical and comprises two identical transistors 25 which may be for example, of the NPN type sold under No. 2 N 3926 by the MOTOROLA Company.

The collector of each transistor 25 is connected to a 12 volt DC supply through a conductor 32 and a coil 33. A conductor 44 is connected across the two emitters of the transistors 25 and connects these emitters to ground.

The bases of the two transistors 25 are connected by conductors 36 and the coil 35. Moreover the base of each transistor 25 is connected to the 12 volt DC source through a resistance 19.

In a particular embodiment of a frequency of 220 megacycles is obtained with electronic components having the following characteristics:

Each of the polarizing resistances 19 have a value of 2.2 kilo-ohms.

The two coils 33 and the coil 35 are wound on a core having a diameter of 20 mm with the turns of one coil interfitting between the turns of the other. In order to simplify the drawings the coil 33 and 35 have been shown on FIG. 4 with different diameters using lines of different thickness, but in the embodiment in question the diameters of the coils are the same and the coils are made from a copper wire having a diameter of 0.6 of a mm.

The coil 35 has ten turns wound over a length of 40 mm. Each coil 33 has six turns wound over a length of 6.5 mm.

It will of course be appreciated that the embodiments which have been described have been given purely by way of illustration and example and may be modified as to detail without thereby departing from the basic principles of the invention. In particular, it is obvious that the relative position of the hair and the other components inside the resonator may be modified without affecting the principles of the invention. Moreover, it is obvious that the shape or structure of the different electrical components inside the jacket of the resonator may be modified in order to change or adjust the frequency of the latter.

What is claimed is:

1. Device for treating hair by subjecting it to the action of a high frequency electromagnetic field which comprises an electromagnetically closed and electrically conductive jacket constituting a resonator, means inside said jacket for receiving the hair, coupling means for distributing high frequency electromagnetic energy inside the jacket and means closely associated with the jacket for producing at least the greater part of the high frequency electromagnetic energy dissipated in said resonator.

2. Device for treating hair by subjecting it to the action of a high frequency electromagnetic field which comprises an electromagnetically closed and electrically conductive jacket constituting a resonator, means inside said jacket for receiving the hair and a high frequency generator closely associated with the jacket for producing the electromagnetic energy dissipated in said resonator, said resonator comprising a coupling member for distributing high frequency electromagnetic energy inside the jacket and said coupling member being a component of an oscillating circuit.

3. Device as claimed in claim 2 in which said generator comprises a transistor, the base of which is connected to a first coil, the other end of which coil is free, a source of direct current connected to the collector of said transistor through a second coil coaxial with the first, the emitter of said transistor being grounded and its base connected through a resistance to said direct current source.

4. Device as claimed in claim 2 in which the high-frequency generator has a symmetrical circuit comprising two identical transistors, the emitters of which are grounded, the bases of which are connected to each

7

other through a coil and to a source of direct current through a coil coaxial with the coil connecting the bases of the transistors.

5. Device as claimed in claim 2 comprising means for producing pulses in a direct current supplying said gen-

8

erator to trigger oscillation thereof.

6. Device as claimed in claim 1 in which said coupling means is supplied by a high frequency generator supplied from a source of direct current.

* * * * *

10

15

20

25

30

35

40

45

50

55

60

65

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,760,148 Dated September 18, 1973

Inventor(s) GEORGES BOUDOURIS, GREGOIRE KALOPISSIS, JEAN-LUC
LEVESQUE & PAUL ROUSSOPOULOS

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

[30] Foreign Application Priority Data

December 21, 1970 Luxembourg . . . 62,291

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,760,148 Dated September 18, 1973

Inventor(s) GEORGES BOUDOURIS, GREGOIRE KALOPISSIS, JEAN-LUC
LEVESQUE & PAUL ROUSSOPOULOS

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

[30] Foreign Application Priority Data

December 21, 1970 Luxembourg . . . 62,291

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents