



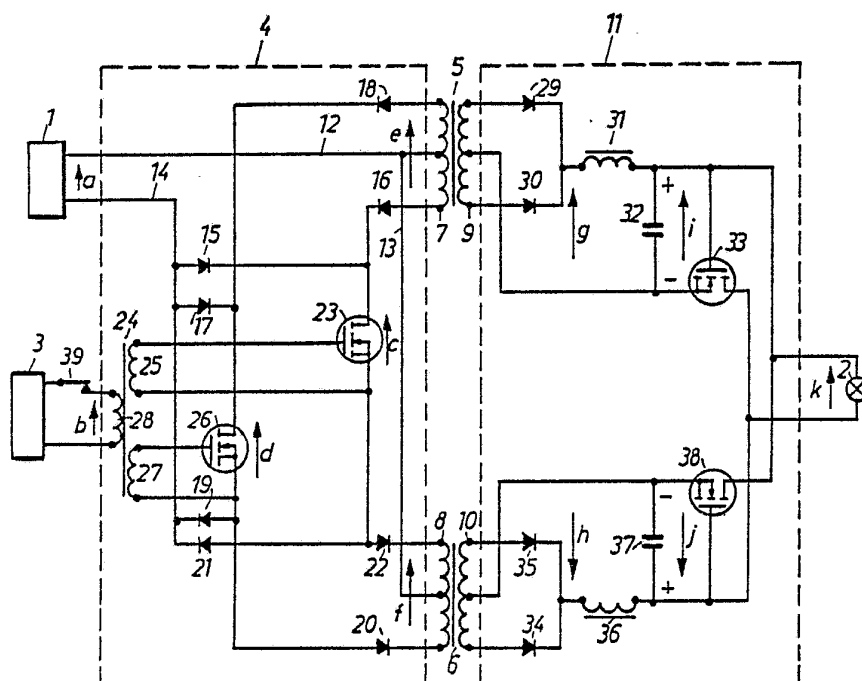
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(54) Title: METHOD OF SECURELY INTERRUPTING THE ELECTRIC POWER SUPPLY FROM A LOW-FREQUENCY OR DIRECT VOLTAGE SOURCE TO A LOAD, AND APPARATUS FOR CARRYING OUT THE METHOD

(57) Abstract

Method and apparatus for secure interruption of the supply of electric power from e.g. a low-frequency source (1) to a signal lamp (2) which when alight announces permission for a train to pass. The output voltage (a) of the source (1) is chopped by a chopper device (4) to a high-frequency alternating voltage (e, f) in response to a high-frequency input signal (b) to the chopper device (4) and is transferred from the primary to the secondary side of a transformer (5, 6) as well as being rectified and filtered to form a voltage (k) applied to the signal lamp (2), said voltage (k) having a wave form corresponding to the wave form of the output voltage (a) of the source (1) and which is securely interrupted by interrupting the input signal (b) to the chopper device (4).



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METHOD OF SECURELY INTERRUPTING THE ELECTRIC POWER SUPPLY
FROM A LOW-FREQUENCY OR DIRECT VOLTAGE SOURCE TO A LOAD,
AND APPARATUS FOR CARRYING OUT THE METHOD

TECHNICAL FIELD

The present invention relates to a method for secure interruption of the supply of electric power from a low-frequency or direct voltage source to a load, and an apparatus for carrying out the method.

BACKGROUND ART

In railway signalling technology, the secure interruption of electric power to a
5 load is of the greatest importance, the load being e g a signal lamp which, when
illuminated, announces "permission to pass" for a train. Relays have so far been
used in the art to achieve this interruption. However, relays are burdened with
the disadvantages that they are voluminous, heavy, expensive to manufacture,
environmentally sensitive and that they have limited working life with respect
10 to the number of interruptions.

DISCLOSURE OF INVENTION

The object of the present invention is to eliminate the disadvantages associated
with relays in this connection.

This object has been achieved by the method and apparatus in accordance with
the invention having been given the characterizing features disclosed in the
15 claims.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described in detail below, with reference to the
accompanying drawing, whereon Figure 1 is a circuit diagram of an embodiment
of the inventive apparatus, and Figures 2a-2k illustrate the voltages at
different points in the diagram of Figure 1.



MODE FOR CARRYING OUT THE INVENTION

Figure 1 is a circuit diagram of an embodiment of an apparatus for securely interrupting the supply of electric power from a low-frequency source 1 to a load 2. In the illustrated embodiment this load is assumed to be a railway signalling lamp which when it is alight announces passage permission to a train.

5 A direct voltage source may of course be used instead of the low-frequency source 1.

In accordance with the invention, the output voltage a of the low-frequency source 1 is applied to a chopper device 4, adapted for chopping the low-frequency voltage a, the appearance of which will be seen from Figure 2a, to a

10 high-frequency alternating voltage in response to a high-frequency signal b, the appearance of which will be seen from Figure 2b, and which is supplied to the chopper device 4 from a signal source 3. The high-frequency input signal b to the chopper device 4 may be interrupted, as indicated in Figure 1 by a break-contact 39. The high-frequency alternating voltage generated by the

15 chopper device 4, having the appearance illustrated in Figures 2e and 2f, is applied to an interface with the property of only being able to transfer high-frequency energy. In the embodiment illustrated, this interface comprises two transformers 5 and 6, having primary windings 7 and 8, respectively. The respective secondary windings 9 and 10 of these transformers are connected to

20 a rectifying and filtering device 11, for rectifying and filtering the high-frequency alternating voltages on the secondary sides of the transformers 5 and 6 to form a voltage k, the appearance of which will be seen from Figure 2k, and which is applied to the signal lamp 2.

The illustrated apparatus is implemented such that the voltage k to the signal

25 lamp 2 is securely interrupted when the voltage b from the signal source 3 is interrupted.

One output terminal on the low-frequency source 1 is connected via a conductor 12 to the centre tap of the primary winding 7 of the transformer 5, this tap being in turn connected by a conductor 13 to the centre tap of the

30 primary winding 8 of the transformer 6. The other output terminal of the source 1 is connected via a conductor 14 to:



- a) the anode of a diode 15, the cathode thereof being connected to the cathode of a diode 16, the anode of this diode being connected to one end of the primary winding 7 of the transformer 5,
- b) the anode of a diode 17, the cathode thereof being connected to the cathode of a diode 18, the anode of this diode being connected to the other end of the primary winding 7 of the transformer 5,
- c) the cathode of a diode 19, the anode thereof being connected to the anode of a diode 20, the cathode of this diode being connected to one end of the primary winding 8 of the transformer 6, and
- 10 d) the cathode of a diode 21, the anode thereof being connected to the anode of a diode 22, the cathode of this diode being connected to the other end of the primary winding 8 of the transformer 6.

The connection point between the cathodes of diodes 15 and 16 is connected to the collector of a field effect transistor 23, the emitter of which is connected 15 to the connection point between the anodes of diodes 21 and 22, and the gate of which is connected to one end of a first secondary winding 25 of a transformer 24, the other end of said winding being connected to the emitter of the transistor 23.

The connection point between the cathodes of diodes 17 and 18 is connected to 20 the collector of a field effect transistor 26, the emitter of which is connected to the connection point between the anode of diodes 19 and 20 and also to one end of a second secondary winding 27 of the transformer 24, the other end of said winding being connected to the gate of the transistor 26.

The primary winding 28 of the transformer 24 is connected via the break-con- 25 tact 39 between the two output terminals of the voltage source 3.

One end of the secondary winding 9 of the transformer 5 is connected to the anode of a diode 29, the cathode thereof being connected to the cathode of a diode 30, the anode of this diode being connected to the other end of the winding 9. The connection point between the cathodes of diodes 29 and 30 is 30 connected to one end of a coil 31, the other end of which is connected to

- a) one terminal of a capacitor 32, the other terminal thereof being connected to the centre tap of the secondary winding 9 of the transformer 5 and



b) the gate of a field effect transistor 33, having its emitter also connected to the centre tap of the secondary winding 9 and its collector connected to one terminal of the signalling lamp 2, the other terminal of which is connected to the gate of the field effect transistor 33.

5 One end of the secondary winding 10 of the transformer 6 is connected to the anode of a diode 34, the cathode thereof being connected to the cathode of a diode 35, the anode of this diode being connected to the other end of the secondary winding 10. The connection point between the cathodes of diodes 34 and 35 is connected to one end of a coil 36, and the other end of this coil is
10 connected to

- a) one terminal of a capacitor 37, having its other terminal connected to the centre tap of the secondary winding 10 of the transformer 6, and
- b) the gate of a field effect transistor 38, having its emitter also connected to the centre tap of the secondary winding 10, and its collector connected to the
15 gate of the transistor 33, the collector of which is in turn connected to the gate of the transistor 38.

When the voltages according to Figures 2a and 2b appear at the respective outputs of the low-frequency source 1 and the voltage source 3, the emitter-collector voltage of the field effect transistor 23 will have the appearance
20 shown in Figure 2c, while the emitter-collector voltage of the field effect transistor 26 will have the appearance shown in Figure 2d.

The voltage across the primary winding 7 of the transformer 5 will have the appearance shown in Figure 2e, while the voltage between the connection point of the diodes 29 and 30 and the centre tap on the secondary winding 9 of the
25 transformer 5 will have the appearance shown in Figure 29.

The voltage across the primary winding 8 of the transformer 6 will have the appearance shown in Figure 2f while the voltage between the connection point of diodes 34 and 35 and the centre tap on the secondary winding 10 of the transformer 6 will have the appearance shown in Figure 24.

30 The voltages from the secondary windings of the transformers 5 and 6 are rectified with the aid of diodes 29, 30 and 34, 35, respectively, while the



high-frequency components from the chopper device 2 are filtered out by the filters comprising coil 31 and capacitor 32 and coil 36 and capacitor 37, respectively.

After filtering, the emitter-gate voltage of the transistor 33 will have the appearance shown in Figure 2i while the emitter-gate voltage of the transistor 38 will have the appearance shown in Figure 2j. This results in that the voltage across the signal lamp 2 will have the appearance shown in Figure 2k. The voltages from the secondary windings of the transformers 5 and 6 are rectified by the diodes 29, 30 and 34, 35, respectively, while the high-frequency components from chopping by the chopper device 4 are filtered out by the filters comprising coil 31 and capacitor 32 and coil 36 and capacitor 37, respectively.

The purpose of the field effect transistors 33 and 38 is to prevent one rectifier from conducting current to the load 2 when the other transformer supplies voltage, and vice versa, since both rectifiers would otherwise constitute short circuits for each other, in respect of the output voltage of the apparatus.

The field effect transistors 33 and 38 may of course be replaced, either by bipolar-type transistors or by thyristors. This also applies to the field effect transistors 23 and 26 in the chopper device 4.

There will thus be no power supplied to the signal lamp 2, when the high-frequency input signal b is interrupted, since no voltage is obtained across the respective primary windings 7 and 8 of the transformers 5 and 6. The interruption of power will thus be secure within the meaning implied in railway signalling technology, since no component failure can give rise to the high-frequency control signal which provides the chopping necessary for the output voltage a of the low-frequency source 1 to be transferred to the secondary side of the transformers 5 and 6. These transformers 5 and 6 are further implemented such that they can only transfer high-frequency energy. Accordingly, such component failures will be harmless as could cause the voltage from the low frequency source 1 to be directly applied to the primary windings, since the transformers become saturated when low-frequency voltage is applied to their primary windings. Since the primary and secondary sides of the transformers 5



and 6 are mutually, galvanically isolated by an isolation of a high isolation class, the probability of leakage voltage is so small that it may be neglected.

In accordance with the invention there has thus been provided a method and apparatus for the secure interruption of the supply of power from a low-frequency or direct voltage source to a load.



CLAIMS

1 Method for secure interruption of the supply of electric power from a low-frequency or direct voltage source (1) to a load (2), characterized in that the output voltage (a) of the source (1) is chopped to a high-frequency alternating voltage (e, f) in response to a high-frequency signal (b),

5 that the high-frequency alternating voltage (e, f) is transferred from one side to the other of an interface (5, 6) having galvanic isolation and intended for transmission of high-frequency alternating voltages only,

that the high-frequency alternating voltage on the other side of the interface is rectified and filtered to form a voltage (k) supplied to the load (2), the wave
10 form of said voltage corresponding to that of the output voltage (a) of the source (1), and

that the voltage (k) supplied to the load (2) is interrupted by interrupting the high-frequency signal (b).

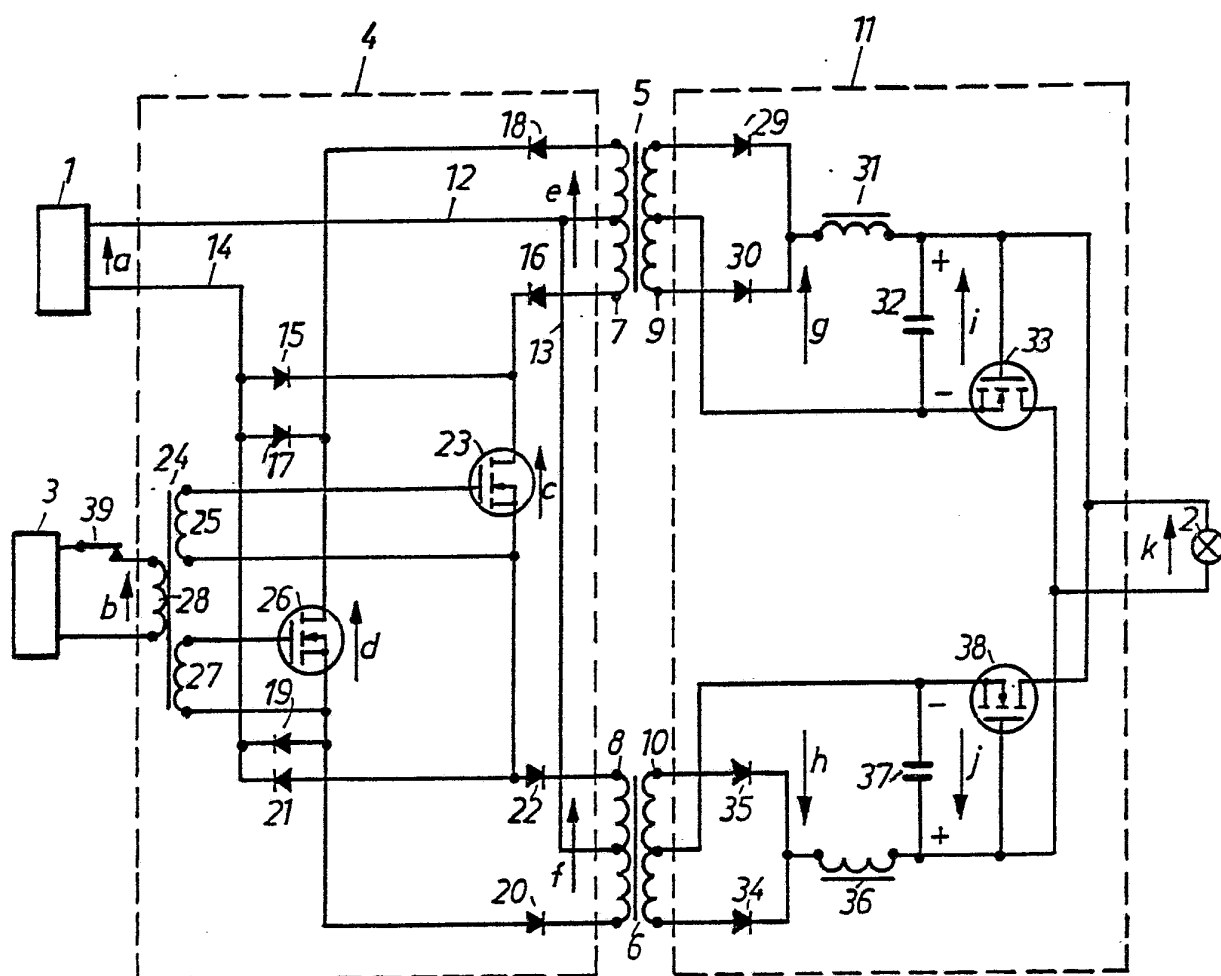
2 Apparatus for secure interruption of the supply of electric power from a low-frequency or direct voltage source (1) to a load (2), characterized in that a chopper device (4) is adapted to chop the output voltage (a) of the source (1) to a high-frequency alternating voltage (e, f) in response to a high-frequency input
5 signal (b) to the chopper device (4), that there is an interface (5, 6) having galvanic isolation and intended for transmission of high-frequency alternating voltages only for transferring the high-frequency alternating voltage (e, f) from one side to the other of the interface, that a rectifying and filtering device (29, 30, 31, 32, 34, 35, 36, 37) is disposed for rectifying and filtering the
10 high-frequency alternating voltage on the other side of the interface for forming a voltage (k) which is applied to the load (2) and which has a wave form corresponding to that of the output voltage (a) of the source (1), and that there are means (39) for interrupting the high-frequency input signal (b) to the chopper device (4) for interrupting the voltage (k) supplied to the load (2).

3 Apparatus as claimed in claim 2, characterized in that the interface (5, 6) comprises a transformer, the primary side (7, 8) of which constitutes said one side, and the secondary side (9, 10) of which constitutes said other side.



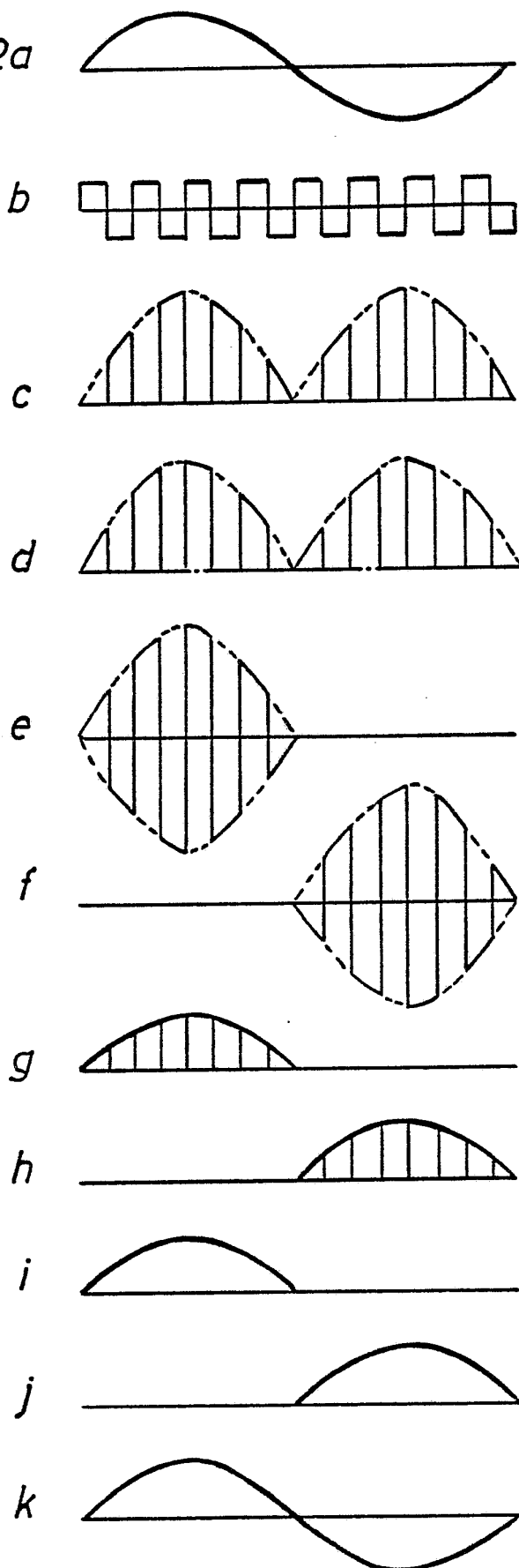
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Fig. 1



$2/2$

Fig. 2a



INTERNATIONAL SEARCH REPORT

International Application No. PCT/SE83/00023

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 3		
H 03 K 17/00, /51		
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC 3	G 08 C 19/00, H 02 M 5/00, 10, 18, 40-458, H 02 P 13/18	
	H 03 K 17/00, 02, 18-26, 51, 56, 687, 78	
US C1	246:14-15, 20-26, 34, 63, 104-105 .../...	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
SE, NO, FI, DK classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT 14		
Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
A	US, A , 3 495 097 (PAUL ABRAMSON ET AL) 10 February 1970	1-3
A	US, A , 3 705 313 (MITSUO OHSAWA) 5 December 1972	1-3
A	US, A , 4 136 288 (MICHEL KNAPP-ZILLER ET AL) 23 January 1979	1-3
A	FR, A , 2 139 130 (GENERAL ELECTRIC COMPANY) 5 January 1973	1-3
A	IBM Technical Disclosure Bulletin, Volume 16, No.5, issued 1973 October (Armonk, New York), E.C. HEITMAN, "Triac frequency multiplier", see pages 1582-1583	1-3
* Special categories of cited documents: 16 "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 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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 "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		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search *		Date of Mailing of this International Search Report *
1983-05-02		1983-05-18
International Searching Authority *		Signature of Authorized Officer 20
Swedish Patent Office		Stig Edhborg

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields searched (cont.)

US C1 307: 106-107, 112, 125-132, 139-144,
 151, 239-244, 261
 321:2
 363:1-34

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter¹² not required to be searched by this Authority, namely:
2. ☐ Claim numbers 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 out¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

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 of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ 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 claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

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