**Title:** EMERGENCY DEVICE FOR ELEVATORS

**Abstract**

An emergency device for elevators, which enables the elevator when the power is cut-off, to move to the closest lower floor. The prior art devices either use third party assistance to remove the passengers or the elevator cable pulley brake is released. The device employs a hydraulic unit which allows the elevator car to move to the next lowest floor (18) when the car stops due to the cut-off of electric power. The device further has a travel limiting-locking unit (15) for maintaining hydraulic cylinders (1) withdrawn and locked and again locked when the cylinders (1) are extended when the elevator car moves to the next lowest floor (18). Finally, the device utilizes a door-opening unit to permit the elevator door (36) to open by a motor (38) after the elevator car has arrived at the next lowest floor (18).
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"EMERGENCY DEVICE FOR ELEVATORS".

The present patent relates to an emergency device applied to elevators, which enables the elevator, in the event of interruption of the electric power supply, to move to the closest lower floor, without need for human interference and without the elevator cable pulley brake being released.

At present, the state of emergency in elevators - sudden stopping of the elevator due to electric power being cut - is cared for by use of one of the expedients:

- by releasing the elevator cable pulley, done manually with a steel bar or similar object, through separation of the brake linings thereof. In addition to the risks that such a procedure offers to the operator, this operation has other inconveniences, such as delayed service, the slow, uncomfortable and distressing descent of the elevator in intermittent jolts that may eventually cause damage to the equipment. It is serious, also, that this operation should involve handling of one of the elevator's safety devices,

- by use of a standby electric power generator, a very expensive piece of equipment, normally only employed in a few large-sized buildings;

- by removing the passengers, with the aid of third parties, through openings available in some types of elevators.

- finally, the most dangerous and least recommended procedure is for the people locked inside the cabin to attempt to escape on their own by forcing the elevator doors and jumping across narrow gaps, between the elevator floor and the upper part of the outer door frame, thus running the risk of falling into the elevator shaft.

For the purpose of dismissing such inconveniences and providing an emergency device that will afford safe and speedy service to people locked in elevators, conveying them smoothly, comfortably and without the aid of other people to the next lowest floor, the present invention was developed, which is an emergency device for elevators, comprised by four
basic units and that can be installed either in home elevators, or those in commercial or industrial buildings, regardless of whether new or in use.

The developed emergency device for elevators is comprised by a hydraulic unit, a travel limiting-locking unit, an emergency elevator door-opening unit, and a normal-state recovering unit, in which the hydraulic unit is intended to enable, upon occurrence of electric power failure and through distension of the hydraulic cylinder thereof, the elevator car to be displaced to the next lowest floor, notwithstanding the immobility of the elevator cable caused by the braking of its pulley; the travel limiting-locking unit is designed basically to perform the functions of, during normal elevator operation, maintaining the piston and rod withdrawn and locked inside their hydraulic cylinder. The hydraulic cylinder, in this situation, acts as if it were a rigid coupling component between the end of the elevator cable and the elevator car and, upon electric power failure, unlocking the hydraulic cylinder to free its distensibility and, on a second opportunity, to limit the travel of this distension until the elevator car, integral with one of the extremities of the hydraulic cylinder, reaches the next lowest stop; the door-opening emergency unit is designed to ensure, upon actuation of the elevator emergency device, that the door of the elevator be opened as soon as the latter is displaced to its next lowest stop, and the normal-state recovering unit is intended to enable the elevator to return to its normal working condition when electric power is restored.

The emergency device, object of the present invention, can be better understood from a description of the annexed schematic figures, which represent a preferred embodiment, without restricting or limiting it however, in which:

- Figures 1 and 1A represent front views of elevators, fabricated according to the present invention and operating in normal conditions relative to their electric power supply. In figure 1, a hydraulic cylinder is employed,
of the rigid-rod type, and, in figure 1A, a hydraulic cylinder of the telescopic type.

- Figures 2 and 2A represent front views of elevators, showing the emergency devices operating as a result of electric power interruption.

- Figure 3 is a view of the upper portion of an elevator car, in normal operation, showing an enlarged reproduction of the main components of the emergency device for elevators.

- Figure 4 is an enlarged detail of the magnetic switch in a repose condition.

- Figure 5 is a view of the upper portion of the elevator car, showing an enlarged representation of the main components of the emergency device for elevators, when this is operated.

- Figure 6 is an enlarged detail of the magnetic switch while being operated.

- Figure 7 is a diagram of the hydraulic unit.

- Figure 8 is a diagram of the main electric circuits of the emergency device for elevators.

As can be seen in figures 1, 1A, 2 and 2A, the developed emergency device for elevators comprises a hydraulic unit made up by one or more hydraulic cylinders (1), with a solid or telescopic piston rod. The hydraulic cylinder (1) acts as a coupling member between the end of the cable (2) and the car (3) of the elevator. Thus, one of the ends of the hydraulic cylinder (1) is connected to the elevator cable (2) and the other to the elevator car.

The location, quantity and type of hydraulic cylinders (1) will be determined by the technical conditions of the elevator design.

For the purpose of the general description of this invention, it shall be assumed that two hydraulic cylinders (1) have been applied, installed at the sides of the elevator car (3), along the side beams (4) of the frame of the elevator car (3). The tubes of the cylinders (1) are connected by their covers at the head end (5) to the extremities (6) of the bottom beam (7) of the frame of the elevator car (3).
The ends of the rods (8) of the hydraulic cylinders (1) are connected to the ends of the coupling bar (15), which is part of the travel limiting-locking unit, now to be described in detail.

The travel limiting-locking unit, in the example shown in figures 3 and 5, includes the following components: direct-current electric motor (10) with a cogwheel (11) at the end of its shaft, two locking shafts (12), disposed on one of the side faces of the top beam (13), which slide horizontally through their retaining clamps (14), coupling bar (15), circuit changeover and reversing switches (16) and (17), stops (18) and magnetic switch (19). Among other possible alternatives, this unit can be driven hydraulically or by action of a magnetic force.

The coupling bar (15) is superposed on the top beam (13) and is connected, at its central portion (20), to the elevator cable (2) and, at its ends, to the rods (8) of the hydraulic cylinder (1). The coupling bar (15) includes two arms (21), each with an eyelet (22), where the locking shaft (12) is housed.

One of the arms (21) is provided with the boss (23) designed for operation of two switches: the changeover switch (17) of the travel limiting-locking unit motor (10) and the circuit-breaker switch of a motor that drives a hydraulic pump of the hydraulic unit.

Each of the shafts (12) has three distinct segments: the first, facing the central portion of the top frame beam (13) is the locking shaft (12) and is designed to lock the emergency device for elevators according to the present invention, during normal operation of the elevator, since, in this situation, it will have its end fitted into the eyelet (22) of the arm (21) of the coupling bar (15). The latter, as was mentioned before, has its center connected to the elevator cable (2) and ends connected to the ends of the rods (8) of the hydraulic cylinders (1); the second segment, located at the central portion of the shaft (12), is the segment having cogs on it (25), which mesh with the cogwheel (11) coupled to the motor (10); the third and last
segment, located at the end of the shaft (12), facing the end of the top frame beam (13) is the checking segment (26), the purpose of which is, together with the stop (18) fixed to the inner wall of the elevator shaft, limit travel of the elevator car (3) to the next lowest stop, when the emergency device for elevators is operated.

A double-acting boss (12') is provided on one of the shafts (12), which is used both for operating the changeover and reversing switches (16) and (17), interrupting displacement of the shafts (12) at the end of each of their respective travels, on which occasion the direct-current electric circuit of the motor (10) is reversed, and for operating a double check valve (44) in the hydraulic unit, releasing hydraulic fluid to pass in the direction from the hydraulic cylinder (1) to the fluid reservoir.

The stops (18) are located along the inner walls of the elevator shaft, so that the plumb line passing through the center of their front faces is contained in the same imaginary plane that contains the horizontal line defined by the checking segments (26).

Therefore, when the elevator moves within the shaft, the thrust segments (26) will ride along exactly opposite the stops (18).

For each floor, except the last, stops (18) will be secured to the inner walls of the elevator shaft, in perfect register with the position of the thrust segment (26) on the elevator car (3), so that the latter, upon operation of the emergency device for elevators, object of the invention, may have displacement interrupted exactly at the stop of the next lowest floor.

The magnetic switch (19) is installed at the end of the thrust segment (26) and is used to trigger operation of the emergency device for elevators, in the event of electric power failure.

The magnetic switch (19) includes a travel-limiters rod (27), an electromagnet (28), two contact terminals (29) in the direct-current electric circuit of an emergency lamp (30), two contact terminals (31) in the direct-current
electric circuit of the motor (10), an expansion spring (32) and a hydraulic delay component (33).

During normal operation of the elevator, the travel-limiting rod (27) has its changeover blade (34) held to the electromagnet (28) by magnetic action. The thrust head (35) at the other end of the travel-limiting rod (27) faces the end of the thrust segment (26).

In the event of interruption of electric current feeding the elevator, the electromagnet (28) frees the travel-limiting rod (27) which, by action of the expansion spring (32), advances in the direction of the thrust segment (26), going slightly beyond it.

The distance covered by the travel-limiting rod (27) comprises two stages: in the first, the changeover blade (34) establishes immediate connection of the contact terminals (29) of the direct-current electric circuit of the emergency lamp (30) of the elevator cabin (36), lighting it up; the second is a delayed-effect stage due to action of the hydraulic delay component (33) of the emergency switch (19), with a short period of time elapsing - 10 to 15 seconds, for example - for the changeover blade (34) to reestablish connection of the contact terminals (31) of the direct-current electric circuit of the motor (10) of the travel-limiting-locking unit.

In the event that the elevator car (3), due to electric power failure, happens to park exactly in the situation in which the checking segment (26) meets the front face of the stop (18), the travel-limiting rod (27) will be prevented from moving any further by the thrust head (35) abutting the front face of the stop (18), which restrains the changeover blade (34) from accomplishing its second stage. The first stage, which corresponds to connecting the contact terminals (29) of the direct-current electric circuit of the emergency lamp (30) of the elevator cabin (36), will be carried out.

There is a further changeover switch (37), installed at the end of the thrust head (35), which is part of the door-opening unit, now to be described.
The door-opening unit of the elevator includes the
direct-current electric motor (38), changeover switch (37)
and end-of-travel switch (39).

The electric motor (38) has its pulley connected
to the wheel (40) of the normal door-opening device, by means
of a belt.

The changeover switch (37) is installed at the
dge of the thrust head (35) of the magnetic switch (19).
This changeover switch (37) is actuated when the thrust head
10 (35) abuts the upper or front part of the stop (18).

The fourth unit, which is the normal-state recover-
ering unit, includes a circuit breaker (41), installed in
the machine room, a changeover switch (42) of the hydraulic
unit, also located in the machine room, and safety bolts
15 (43), located on the elevator cabin door.

The circuit breaker (41) is used to prevent automatic return of electric power to the elevator's electric
circuit, when this is restored.

It shall be of the delayed-action type, so as to
20 prevent it from cutting out in the event of brief inter-
ruption of the electric power - from 10 to 15 seconds, for
example. After this time interval, it will only be possible
to supply electric power again to the elevator by manual
means.

The changeover switch (42) is used to connect the
alternating-current electric circuit of the hydraulic unit
motor, which triggers recovery of the elevator's normal
operating system, now to be described.

The safety bolt (43) is installed on each of the
30 outer doors of the elevator stops, except the one corre-
sponding to the last upper stop. The safety bolt (43) is
used to manually lock, with a special key, available only to
the building's administration, the outer door of the stop
where the elevator car (3) parked after completion of
35 operation of the emergency device for elevators according to
the present invention.

This locking of the outer door prevents that,
during the operation in which the elevator is restored to
normal working condition, some person should inadvertently enter the cabin (36).

Figures 7 and 8 present schematic diagrams of the hydraulic unit and principal electric circuits of the device according to the present invention, and shall be described together with the description of the operation of the emergency device for elevators, object of the present invention, the direct-current electric circuits of which are fed by a battery of alkaline or rechargeable nickel-cadmium accumulators (45).

In figure 7, it will be noted that the hydraulic unit comprises the hydraulic cylinder (1), which is the main element, and other elements required for it to work, such as the direct-current electric motor (47), hydraulic pump (48), fluid reservoir (46), manifold block (52), relief valve (53), electric directional valve (49), double check valve (44), return filter (54), filler mouth with air cleaner (55), suction filter (56), pipes, connections and other necessary appurtenances.

The hydraulic motor-pump set may be substituted for a manually operated pump.

When the elevator's supply of electric power is interrupted, the delayed-action circuit breaker (41) interrupts the elevator's electric circuit, which can only be reactivated later and by manual means. The circuit breaker's delayed action makes it possible for this switch, during a short lapse of time, to return to its repose condition, in the event that the elevator's electric current is restored. The travel-limiting rod (27) of the magnetic switch (19), being freed from the magnetic attraction of the electromagnet (28), advances due to the action of the expansion spring (32), carrying with it the changeover blade (34), to which it is integrally attached. In the first stage of the distance covered, the changeover blade (34) establishes immediate connection of the contact terminals (29) of the direct-current electric circuit to the emergency lamp (30), which goes on and lights up the elevator cabin. In the delayed-action second stage, the changeover blade (34) establishes
immediate connection of the contact terminals (29) of the
direct-current electric circuit to the emergency lamp (30),
which goes on and lights up the elevator cabin. In the
delayed-action second stage, the changeover blade (34)
establishes connection of the contact terminals (31), closing
the direct-current electric circuit to the motor (10) which,
by rotating in a clockwise direction and meshing the
cogwheel (11) with the toothed segments (25) of the shafts
(12), causes these shafts to move in a direction from the
center of the top beam (13) toward the ends thereof. At this
moment, the shaft locking segments (12) are withdrawn from
their respective eyelets (22) located on the arms (21),
freeing the coupling bar (15) from the top beam (13) and,
consequently, from the elevator car (3).

In this situation, the elevator car (3) will be
connected to the elevator cable (2) only through the coupling
bar (15) and rods (8) of the hydraulic cylinders (1).
The thrust segments (26) of the shafts (12), as a
result of displacement of these, advance toward the inside
walls of the elevator hoistway which are then facing them.
The ends of the thrust segments (26) go beyond the
imaginary plumb line connecting the centers of the stops
(18). Thus, the double boss (27) actuates the changeover and
reversing switch (16) at the end of travel of the shafts
(12), disconnecting and reversing direction of the direct-
current electric circuit to the motor (10), consequently
interrupting displacements of said shafts (12). At the same
time, the double boss (27) operates the double check valve
(44), causing release of the hydraulic fluid to flow from
the hydraulic cylinder (1) to the fluid reservoir (46).

By action of gravity, the elevator car, having the
ends (6) of its bottom beam (7) integral with the tubes of
the cylinders (1), through its cover on the head side (5),
causes the hydraulic cylinder (1) to distend slowly, due to
exit of the hydraulic fluid from the inside of the cylinder
tube, through an orifice (45), to the fluid reservoir (46).
As a result, the elevator car moves smoothly downward and
has its travel interrupted when the thrust segments (26) abut
the stops (18) located at the landing zone of the next lowest floor. At this time, the changeover switch (37) engages the upper part of the stop (18) with its lower edge and connects the direct-current electric circuit to the motor (38) of the door-opening unit, operating it and causing the door of the elevator cabin to open, with the motor (38) being disconnected some time later, by the circuit-breaker switch (39), as soon as the cabin door reaches the end of its opening travel.

There are only two possibilities of occurrence of electric power failure in which the developed emergency device will not operate, due to it not being necessary. The first possibility is when the electric power is interrupted for only a very short while, ten or fifteen seconds, for example. In this interval of time, the travel-limiting rod (27) will not yet have fully reached its second stage of displacement. Electric power returning in the meantime will re-energize the electromagnet (28), causing it to attract the travel-limiting rod (27) and making it retreat to its position of repose, that is, held to the electromagnet (28). Under such circumstances, not even the circuit-breaker switch (41) will reach the point where it is actuated, because the delayed action prevents this from happening during the very short time interval being considered. The only component of the emergency device that operates during this lapse of time of electric power interruption is the emergency lamp (30) in the elevator cabin, because the travel-limiting rod (27) of the magnetic switch (19) establishes, through its changeover blade (34), immediate connection of the contact terminals (29) of the direct-current circuit to the emergency lamp (30).

The second possibility of the emergency device not being fully operated occurs when the elevator car (3), as a result of electric power failure, has its travel interrupted exactly after having passed one of the stops. In this case, the travel-limiting rod (27) of the magnetic switch (19) begins to move and reaches the first stage in which its changeover blade (34) makes the connection of the contact
terminals (29) and actuates the direct-current electric circuit to the emergency lamp (30) in the elevator cabin (36). Said travel-limiting rod (27), upon beginning the second stage, has its displacement interrupted due to engagement of its head (35) with the front face of the stop (18).

Opening of the elevator cabin door (36) is accomplished by contact of the vertical edge of the circuit-breaker switch (37) with the front wall of the stop (18), which causes operation of the door-opening unit. When the elevator's electric power is restored, the normal-state recovering unit begins to operate, and the first operation to be performed is of manually locking the outer door of the floor where the elevator car (3) is located. This is done by operating the safety bolt (43) with its key. The motor (47) of the hydraulic pump (48) of the hydraulic unit is connected through its changeover switch (42), which is located, as mentioned before, in the machine room. Simultaneously, the electric directional valve (49) is operated, reversing the flow direction of the hydraulic fluid, which now begins to be from the fluid reservoir (46) to the hydraulic cylinder (1). The return operation of the hydraulic cylinder (1) then begins, due to hydraulic fluid pressure inside the cylinder.

Seeing that the rod (8) and cylinder (1) piston assembly is held stationary due to the braking of the elevator cable (2) pulley (50), to which it is connected through the coupling bar (15), the cylinder (1) tube, due to hydraulic fluid pressure, will then move upward, carrying with it the elevator car (3). At the end of the return travel of the elevator car (3) to its normal position, the boss (27) will successively actuate:

1 - the circuit-breaker switch (17) that connects the motor (10) of travel limiting-locking unit, which will rotate in a counterclockwise direction. The thrust segments (26) retract and move away from the spaces where the stops (18) are contained. The locking shafts (12) fit into their respective eyelets (22), recovering the rigid unit of the coupling bar (15) and top beam (13) assembly. The elevator
car (3) then becomes connected directly to the elevator cable (2).

The double check valve (44) is released from the pressure of the double boss (27) and again interrupts hydraulic fluid flow from the hydraulic cylinder (1) to the fluid reservoir (46).

The boss (27) will actuate the changeover and reversing switch (17) that disconnects the motor (10) at the end of displacement travel of the shafts (12), causing them to become paralyzed; the direct-current electric circuit to the motor (10) is then reversed.

The circuit-breaker switch (51) disconnects the motor (47) of the hydraulic pump (48), thus causing the flow of hydraulic fluid to the inside of the hydraulic cylinder (1) to cease.

The electric directional valve (49) will again have its fluid flow direction reversed, so that it will be ready to, in an eventual and future interruption of the elevator's electric power, allow for hydraulic fluid flow from the hydraulic cylinder (1) to the fluid reservoir (46).

The next operation to be performed is to manually connect the circuit-breaker switch (41), thus reestablishing the normal electric circuit that feeds the elevator. The magnetic switch (19) returns to its original position, by retraction of the travel-limiting rod (27), attracted by the electromagnet (28), disconnecting the direct-current electric circuit to the emergency lamp (30) in the elevator cabin.

The outer door of the floor where the elevator will have interrupted its travel is released from the locking action of the safety bolt (43), by means of its key, with the elevator now being free to work normally on its original electric power supply.

As can be noted, the emergency device for elevators, object of the present invention, is of great utility, and will provide greater safety to elevator users during sudden stops and in emergency situations.

The importance thereof should further be emphasized as an instrument of social concern, since, in the event of
its application, grave problems of people locked inside elevators will be avoided during fires in buildings. Furthermore, it will do away with calls to the Fire Brigade to remove passengers locked in elevators due to electric power failure.
1 - EMERGENCY DEVICE FOR ELEVATORS, characterized in being comprised by a hydraulic unit, composed of one or more hydraulic cylinders (10) interposed between the elevator cable (2) and car (3), with the ends of the rods (8) of the hydraulic cylinders (1) being connected to the elevator cable and the tubes of the hydraulic cylinders (1) connected to the elevator car (3), or vice versa, the tubes of the hydraulic cylinders (1) integral with the cable (2) and the rods (8) of the hydraulic cylinder (1) connected to the elevator car (3); a travel limiting-locking unit comprising an electric motor (10) provided with a cogwheel (11) at the end of its shaft, two locking shafts (12), disposed on one of the side faces of the top beam (13), which slide within clamps (14), coupling bar (15), circuit changeover and reversing switches (16) and (17), stops (18) and magnetic switch (19); an elevator door-opening unit comprising an electric motor (38), connected to the wheel (40), changeover switch (37), installed on the edge of the thrust head (35) of the magnetic switch (19), and end-of-travel switch (39); and a normal-state recovering unit, composed by a circuit-breaker switch (41), of the delayed action type, changeover switch (42) and safety bolt (43).

2 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 1, characterized in that the hydraulic cylinder (1) is provided with a piston with a solid or telescopic rod (8).

3 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 1, characterized in that it further includes the hydraulic unit, an electric motor (47), hydraulic pump (48), fluid reservoir (46) manifold block (52), relief valve (53), electric directional valve (49), double check valve (44), return filter (54), filler mouth with air cleaner (55) and suction filter (56) and the electric motor (47) and hydraulic pump (48) assembly can be replaced by a manual hydraulic pump.

4 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 3, characterized in that the electric motor (47) and hydraulic pump (48) assembly is replaced by a manual hydraulic pump.
5 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 1, characterized in that the coupling bar (15) includes two arms (21), each with an eyelet (22), where the locking shaft (12) is housed, with one of these arms being provided with a boss (23).

6 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 1, characterized in that the shafts (12) contain toothed segments (25) adjoining their far ends, with one of the shafts (12) further containing a boss (12').

7 - EMERGENCY DEVICE FOR ELEVATORS, according to claims 1 or 6, characterized in that the shafts (12) contain extreme thrust segments (26), on one of which is located the magnetic switch (19), comprising a travel-limiting rod (27) with a changeover blade (34), electromagnet (28), contact terminals (29) and (31), expansion spring (32), delay component (33) and thrust head (35).

8 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 3, characterized in that the travel limiting-locking unit is operated hydraulically or by action of magnetic force.

9 - EMERGENCY DEVICE FOR ELEVATORS, according to claim 1, characterized in that it further incorporates an emergency lamp (30) installed inside the elevator cabin (36) and a safety bolt (43) installed on the elevator cabin door (36).
# INTERNATIONAL SEARCH REPORT

**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.

**IPC (4): B66B 1/00, B66B 5/16**

**U.S. CL. 187/32, 73**

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**II. FIELDS SEARCHED**

**Classification System:**

Minimum Documentation Searched

**Classification Symbols:**

U.S. 187/17, 20, 28, 29R, 29A, 32, 33, 51, 73, 77, 78, 80, 81, 27

Documentation Searched other than Minimum Documentation to the extent that such documents are included in the fields searched.

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**III. DOCUMENTS CONSIDERED TO BE RELEVANT***

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of Document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to Claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US, A, 2,308,211, (SANFORD) 12 January 1943  See column 1</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US, A, 969,557, (NORRIS) 06 September 1910  See column 1, lines 24 to 36</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US, A, 4,363,380, (RUED et al) 14 December 1982  See column 1, lines 30 to 39</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>IT, A, 473,639, (NAPOLI) 06 August 1952  See the figure to the left</td>
<td>1</td>
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</tbody>
</table>

* 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.

**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.

**A** document member of the same patent family.

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**IV. CERTIFICATION**

Date of the Actual Completion of the International Search **04 March 1987**

Date of Mailing of this International Search Report **06 APR 1987**

International Searching Authority **ISA/US**

Signature of Authorized Officer **Kenneth Noland**

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Form PCT/ISA/210 (second sheet) (May 1986)