PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 :
C03B 5/225, 5/235

A1

(11) International Publication Number: **WO 82/ 04246**

(43) International Publication Date: 9 December 1982 (09.12.82)

(21) International Application Number: PCT/US81/01464

(22) International Filing Date: 29 October 1981 (29.10.81)

(31) Priority Application Number: 269,226

(32) Priority Date: 1 June 1981 (01.06.81)

(33) Priority Country: US

(71) Applicant: OWENS-CORNING FIBERGLAS CORPORATION [US/US]; Law Department - 26, Fiberglas Tower, Toledo, OH 43659 (US).

(72) Inventors: ERICKSON, Thomas, David ; 649 Canterbury Court, Newark, OH 43055 (US). MINNEN, Pol, Alexandre ; Rue Florikosse, Number 42, B-Verviers (BE).

(74) Agents: PACELLA, Patrick, P. et al.; Law Department - 26, Fiberglas Tower, Toledo, OH 43659 (US).

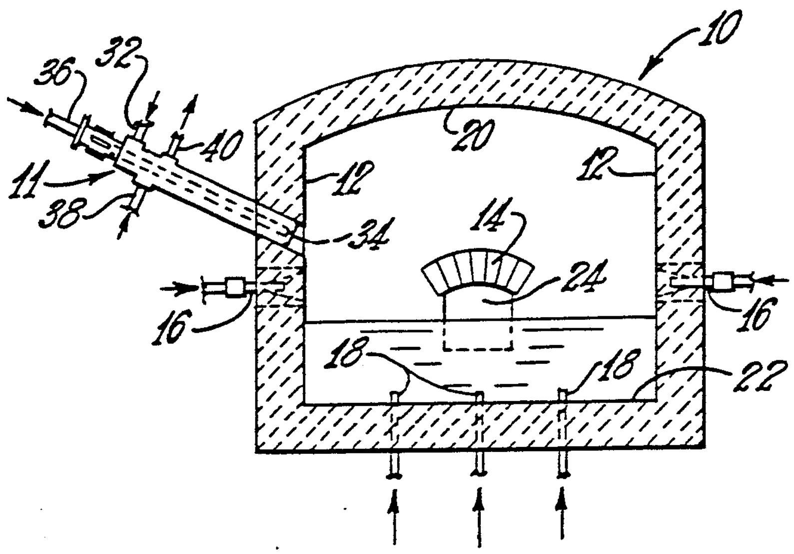
(81) Designated States: AU, DE, FI, GB, JP, NL, NO, SE.

Published
With international search report.
With amended claims.

(54) Title: PROCESS FOR PRODUCING MOLTEN GLASS

(57) Abstract

Method and apparatus for producing heat-softenable mineral into materials such as glass. The process and apparatus carry on processing of mineral material from a batch stage through melting in a furnace (10), delivering streams of the material and attenuating them to filaments and packaging the filaments. By impinging the surface of molten glass with a flame of high energy heat from a burner (11), production is substantially increased and the amount of energy employed per ton of molten glass is reduced.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BG	Bulgaria
BR	Brazil
CF	Central African Republic
CG	Congo
CH	Switzerland
CM	Cameroon
DE	Germany, Federal Republic of
DK	Denmark
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
HU	Hungary
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
RO	Romania
SD	Sudan
SE	Sweden
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
US	United States of America

DESCRIPTION

PROCESS FOR PRODUCING MOLTEN GLASS

TECHNICAL FIELD

This invention relates to the melting of inorganic materials to produce molten glass.

BACKGROUND ART

Conventional glass furnaces include a melting zone into which the raw batch material is charged. Air fuel burner flames are projected into the melting zone to melt the raw material which then flows through a throat in the front wall. Conventionally, glass melting furnaces burn either natural gas or oil.

U.S. Patent 3,856,496, issued December 24, 1974, discloses one modification to the conventional glass melting furnace. Pairs of adjacent burners are mounted in the rear wall of the furnace for melting raw batch material. The angle between the adjacent burners of each pair can be adjusted to increase mixing of fuel and air to ensure complete combustion. The burners also may be adjusted to maximize the area of raw batch covered by the burner flames. The burners produce a flame and create a circulation of hot effluent gases in the interior of the glass tank in a clockwise or counter clockwise pattern.

DISCLOSURE OF INVENTION

We have discovered that by providing a flame of high energy heat and impinging it directly upon the surface of molten glass, production may be substantially increased and a reduction in the amount of energy employed per ton of

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

finished glass may be achieved. This invention is readily adaptable for use with oxygen-enriched burners. The burners actually in service use oxygen and natural gas. In one embodiment the flame is directed at the surface of molten glass open to exposure at the rows of bubbles in the glass melting furnace. In another embodiment, opposed oxygen-enriched burners are located in opposite furnace sidewalls facing each other. The burners are adjusted to maximize the area of molten glass covered by the burner flames. Creating a localized hot spot on the surface of the molten glass is believed to be the critical feature of this process.

The very strong and very localized heat brought to the surface of the molten glass at a given location increases the temperature of the molten glass to such an extent that the throughput of the furnace can be increased with a reduction in the amount of fuel per ton used. This invention satisfies the time/temperature relationship required in melting batch. The high temperature burner is preferred because it increases the temperature of the molten glass without increasing the temperature of the whole melting tank. Merely increasing the energy in conventional burners may not be satisfactory as this tends to make the temperature of the furnaces too high.

Also, increasing glass throughput by conventional methods is not always possible without abnormally increasing total fuel usage. This is uneconomical and often harmful to refractory structure. Conventional heat input would produce so much volume of combustion products that the flames would impinge the refractory and cause its rapid destruction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a glass melting furnace employed to carry out this invention.

FIG. 2 is a rear view of a glass melting furnace employed to carry out this invention.

BUREAU OMPI WIPO INTERNATIONAL

FIG. 3 shows a water cooled nozzle which feeds oxygen directly into the fuel jets.

BEST MODE OF CARRYING OUT INVENTION

This invention may be used to produce conventional wool glass for insulation and ceiling board and to produce conventional textiles and reinforcements such as those made from E glass.

Preferably, this invention relates to a method and apparatus for processing heat-softenable minerals into materials such as glass and, more especially, to a method and apparatus for carrying on processing of mineral or inorganic materials from a batch stage through melting and delivering streams of the material, attenuating the streams to filaments and packaging the filaments. Textile filaments have been produced by attenuating streams of glass from a feeder to filaments by winding the filaments upon a collector or tube in package form.

While only a single oxygen-enriched burner or a pair of such burners is employed in the disclosed embodiment, multiple oxygen-enriched burners are well within the scope of this invention.

FIG. 1 is a side view of a glass melting furnace employed to carry out this invention. Furnace 10 is formed of sidewall 12 and another sidewall, rear wall, front wall, roof and bottom structures (not shown). The front wall 14 contains a port or throat which permits the molten glass to leave the furnace. A row of conventional burners 16 is shown. A number of conventional bubblers 18 also is shown. Water cooled, oxygen gas burner 11 also is shown in position.

The chamber of melting furnace 10 is adapted to be fired or heated by fuel gas or other suitable fuel mixed with air which is preheated in the recuperator to a temperature not exceeding that at which the air may be safely mixed with the fuel gas at the regions of delivery of the fuel gas and air into the fuel chamber at lengthwise spaced regions above the level of the glass in the chamber.

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

As shown in FIG. 1, a row or battery of combustion burners 16 mounted in burner blocks is arranged at each side of the furnace.

Arranged at opposite sides of furnace 10 adjacent the stack or rear end of furnace 10 are batch charging stations including batch feed openings provided with batch chargers or batch feeders not shown. Disposed above each of the batch chargers is a hopper, each hopper being provided with a control valve for regulating the delivery of raw batch into each charger.

The raw materials usually consist of sand, limestone, soda ash, and a borate such as colemanite or ulexite. The batch make-up depends on the type of glass being made and need not contain all of the above materials. Various other materials may be present in small amounts. The glass also may be flux free glasses, i.e., glasses that contain little or no fluxing agents such as boron or fluorine.

The heat necessary for melting the raw materials and for maintaining the molten batch at a desired temperature is provided by two rows of conventional burners 16. The burners are designed to burn a suitable liquid fuel such as oil, or a fuel gas such as natural gas. The type of fuel used depends on what is available commercially, the economy of the fuel, and its suitability for glass melting. The burner pairs are positioned in the sidewall 12 and the opposite sidewall not shown. As previously discussed, FIG. 1 shows oxygen-enriched burner 11 positioned at the rear row of bubblers 18.

FIG. 2 is a rear view of furnace 10 showing one example of the angle at which burners 11 are extended into the furnace. In addition, FIG. 2 shows roof 20 and bottom floor 22. FIG. 2 also shows throat 24 extending through front wall 14.

FIG. 3 shows the detailed features of burner 11. A burner construction wherein the oxygen is injected directly into the fuel at the nozzle is shown in FIG. 3.

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

Burner 11 includes a cylindrical pipe 30 having a fuel inlet 32 which feeds the fuel to the burner. Pipe 30 terminates in a nozzle tip 34 from which the fuel jets are emitted. Oxygen is fed to tube 30 by means 36 so that the oxygen and fuel are emitted together from the nozzle tip 34. To prevent burner 11 from overheating, water a cooled jacket is employed. FIG. 3 shows water inlet 38 and water outlet 40. Burner 11 usually employs bronze rear casting 42 and oxygen quick-disconnect fitting 44.

The temperature of the flame may vary widely. Properly speaking, there is no preferred temperature range for the flame. The temperature generally depends upon the quality of the natural gas and the oxygen/gas ratio. In the following embodiment, the temperature of the oxygen flame is about 2780°C. This figure is substantially higher than the temperature of a conventional burner with air which is about 1950°C.

In one embodiment, the temperature of the flame should be at least 2500°C. The oxygen/gas ratio is adjusted close to stoichiometric, which is a ratio of 1.75:1. Actually, a ratio of 2:1 preferably is chosen for safety. It is extremely important not to fire a reducing gas flame as gas cracking occurs immediately.

In the conventional process of the following embodiment, the surface temperature of the molten glass in the absence of the oxygen flame of this invention usually is 1560 to 1600°C. Accordingly, the temperature of the oxygen flame is at least 1000-1100°C higher than the surface temperature of the molten glass, compared to only a 350°C difference with regard to air flames of conventional burners.

The preferred burners to be employed in this invention use only natural gas and pure oxygen. That is, the burners do not employ an air/oxygen mixture with the fuel. It is within the scope of this invention, however, to employ burners where the use of an air/oxygen mixture may be possible as long as the temperature of the heat

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

source is sufficiently high to (1) increase the throughput of the furnace and (2) reduce the amount of fuel employed per ton of glass.

Example

To demonstrate that this invention achieves increased pull without increasing total fuel per ton usage, the following comparison was made. A conventional glass melting furnace was used as a standard. The fuel usage for the furnace is 17.2 million BTUs per ton of glass. The furnace had a front wall temperature of 1540°C.

With this invention, throughput increased about 26% and the gas consumed by the conventional burners and the oxygen burners equaled 14.4 million BTUs per ton of glass. Oxygen usage was 70 SCFM (standard cubic feet per minute) and the front wall temperature was 1555°C. The improvement in fuel usage was a reduction of about 18% of fuel for the same glass tonnage in the conventional furnace.

Exposed molten material can be found in many regions of the melting chamber. Frequently, the floor of the chamber may be provided with orifices for delivering jets of gas into and upwardly through the molten material. Often, the orifices are arranged in rows transversely of the chamber. In one embodiment, the high intensity heat may be directed at exposed molten material in the region of the chamber near these orifices. In another embodiment, the high intensity heat may be directed at exposed molten material in the region near the row of orifices nearest the batch charging end of the chamber. Still other areas of exposed molten glass may occur in regions near electrodes if electric heating is employed to melt the batch. In still another embodiment the oxygen burners may be installed at the front end of the melter above front bubblers.

INDUSTRIAL APPLICABILITY

This invention can be used with a method and apparatus for processing heat-softenable mineral materials

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

such as glass and, more especially, to a method and apparatus for carrying on processing of mineral or inorganic material from a batch stage through melting, delivering streams of the material, attenuating the streams to filaments and packaging the filaments.

Textile filaments have been produced by attenuating streams of glass from a feeder to filaments by winding the filaments upon a collector or tube in package form.

The invention can be used with a method wherein a series of glass melting and processing facilities or units are employed, each unit provided with a plurality of forehearth sections oriented or arranged in aligned rows and the forehearth sections provided with large numbers of orificed feeders in combination with filament-attenuating and packaging units individual to each feeder or plurality of feeders arranged in an enclosure or chamber wherein the packaging units or devices are disposed in rows along each side of an aisle to facilitate supervision of the operations by a minimum number of operators.

The invention uses a melting and conditioning facility or unit for processing raw batch filament-forming material and conditioning the same suitable for forming textile filaments wherein a plurality of forehearths or forehearth sections are supplied with the material from the unit, the unit being of a size and character to promote a repeated circulation or recycling of the molten material in paths by agitation and convection whereby the material is fined and refined during its circulatory movements in the melting and conditioning unit so that the material is maintained in the unit for a period of time to assure substantially complete degasification of the material and the promotion of homogeneity thereof.

The invention uses a plurality of melting and furnaces or units wherein each unit is provided with a plurality of forehearths or forehearth sections each provided with a plurality of stream feeders or bushings

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

arranged to discharge streams of glass wherein the feeders are aligned in rectilinear rows and the groups of streams are processed to strands of filaments by winding machines disposed in rows beneath the feeders facilitating operation with a minimum number of operators.

The melting units are particularly adaptable for conditioning glass or other mineral material for forming textile filaments wherein the amount of glass processed per unit of time is greatly increased and advantage taken of high melting rates and volume production of filaments to reduce the cost of textile filaments.

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

CLAIMS

1. The method of processing heat-softenable material including feeding batch material into a chamber near one end of the chamber, applying heat to the chamber to melt the batch material, impinging a source of high energy heat upon a portion of the surface of molten material, and flowing molten material through a passage near the other end of the chamber.

2. A method according to claim 1 wherein the source of high energy heat impinges essentially all of the surface of exposed molten glass in the chamber.

3. A method according to claim 1 wherein the source of high energy heat impinges a portion of the surface of the molten glass essentially across the width of the chamber transverse to the flow of molten material in the chamber.

4. A method according to claim 1 including the steps of agitating the molten material at a region and impinging the source of high energy heat on the surface of the molten material at that region.

5. A method according to claim 1 including the step of projecting streams of gas through the molten material at a region and impinging the source of high energy heat on the surface of the molten material at that region.

6. A method according to claim 4 wherein the source of high energy heat impinges at the region of agitating nearest the batch feeding end of the chamber.

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

7. A method according to claim 5 wherein the source of high energy heat impinges at the point of projecting streams of gas nearest the batch feeding end of the chamber.

8. A method according to claim 1 wherein the source of high energy heat is substantially higher than the temperature of the surface of the molten material.

9. A method according to claim 1 wherein the source of high energy heat has a temperature at least 1000°C higher than the temperature of the surface of the molten material.

10. A method according to claim 1 wherein the source of high energy heat has a temperature of at least 2500°C.

11. A method according to claim 1 wherein the source of high energy heat has a temperature of 2780°C.

12. Apparatus for processing heat-softenable material including, in combination, a furnace formed with a melting chamber, means for feeding batch material into the chamber near one end of the chamber, a plurality of heating means associated with the chamber for melting the batch material, means for impinging high energy heat upon a portion of the surface of the molten material, a passage near the other end of the chamber, and means for flowing molten material away from the chamber through the passage.

13. Apparatus according to claim 12 wherein the means for impinging high energy heat is a flame.

14. Apparatus according to claim 12 wherein the chamber has a pair of sidewalls and wherein the means for impinging high energy heat is a high intensity burner associated with each sidewall of the furnace.

15. Apparatus according to claim 12 wherein the chamber has a floor which is provided with orifices arranged in rows transversely of the chamber, said orifices being arranged to deliver jets of gas into and upwardly through the body of molten material in the chamber and wherein the means for impinging high energy heat is

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

directed at the area of the chamber provided with the orifices.

16. Apparatus according to claim 15 wherein the means for impinging high energy heat is directed at the area of the chamber near the row of orifices nearest the means for feeding batch material to the chamber.

17. Apparatus according to claim 12 wherein the means for impinging high energy heat is directed at an area of the chamber which extends essentially transversely across the width of the chamber.

18. Apparatus according to claim 12 wherein the means for impinging high energy heat is a burner with a non-reducing flame and a temperature substantially higher than the temperature of the molten material.

19. Apparatus according to claim 18 wherein the flame has a temperature of at least 1000°C higher than the temperature of the surface of the molten material.

20. Apparatus according to claim 18 wherein the flame has a temperature of at least 2500°C.

21. Apparatus according to claim 18 wherein the flame has a temperature of 2780°C.

22. Apparatus according to claim 18 wherein the burner uses only natural gas and oxygen.

23. Apparatus according to claim 22 wherein the oxygen and natural gas have an oxygen/gas ratio close to stoichiometric.

24. Apparatus according to claim 22 wherein the oxygen and natural gas have an oxygen/gas ratio ranging from 1.75:1 to 2:1.

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

AMENDED CLAIMS
(received by the International Bureau on 29 March 1982 (29.03.82))

1 to 24 cancelled

25. (New) A method for producing glass including the steps of:

feeding glass batch into a melting furnace near one end of the furnace;

heating the furnace to melt the glass batch;

impinging the surface of the molten glass with a flame of high energy heat from at least one oxy-fuel burner; and

withdrawing molten glass near the other end of the furnace.

26. (New) A method according to claim 25 wherein the flame creates a localized hot spot on the surface of the molten glass.

27. (New) A method according to claims 25 or 26 wherein the flame impinges the surface of the molten glass essentially across the width of the furnace transverse to the flow of molten glass in the furnace.

BAD ORIGINAL

BUREAU OMPI WIPO INTERNATIONAL

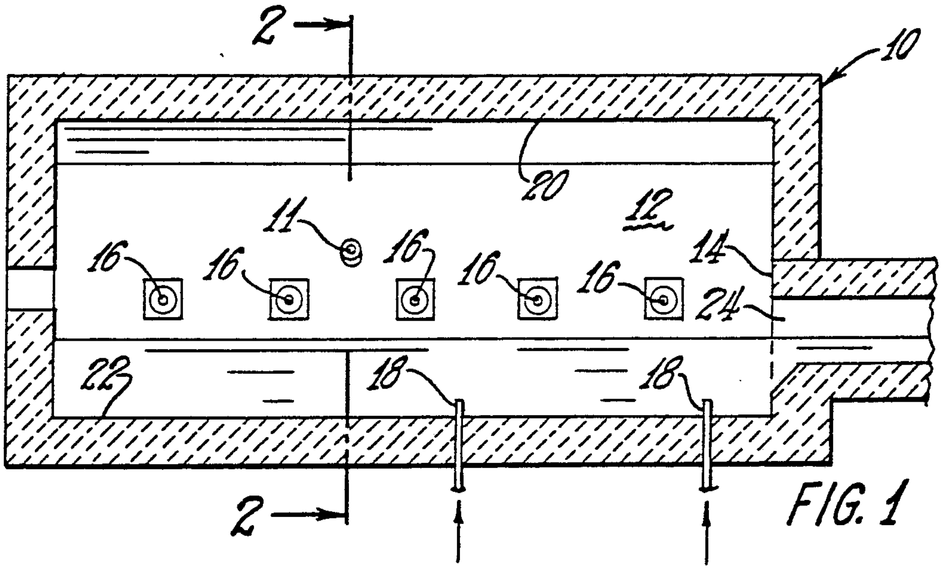


FIG. 1

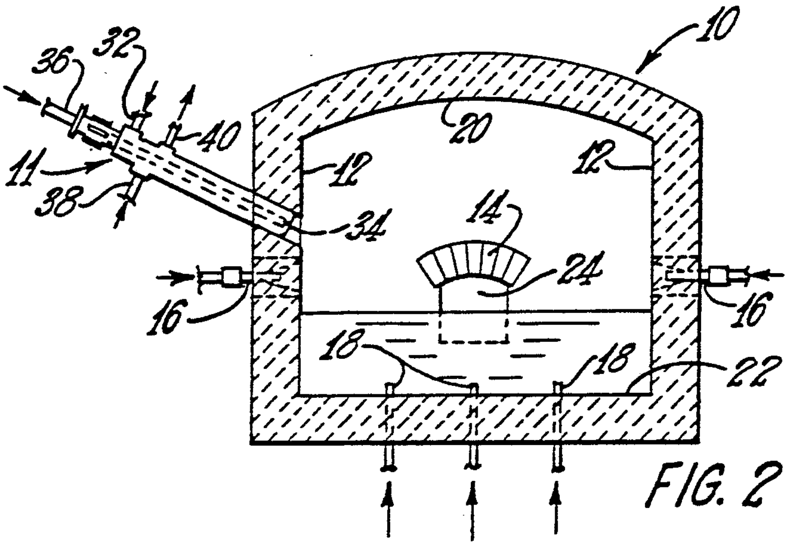


FIG. 2

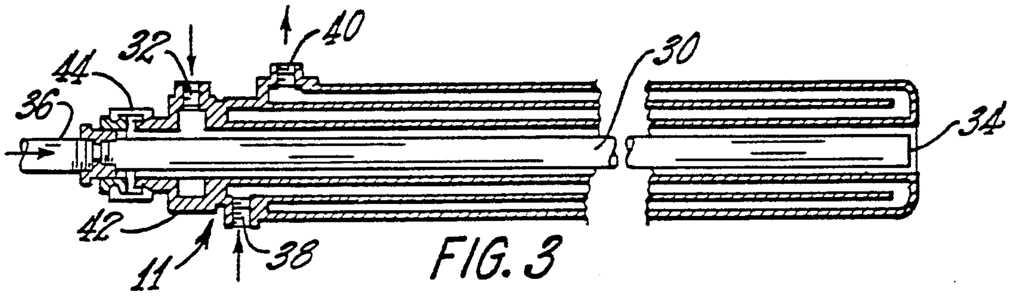


FIG. 3

BUREAU
OMPI
WIPO
INTERNATIONAL

INTERNATIONAL SEARCH REPORT

International Application No PCT/US81/01464

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL.[3] C03B 5/225, C03B 5/235
U.S. CL. 65/136,347

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	65/134,135,136,337,346,347; 432/13,19,20,195

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

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]
X	US,A, 3,015,190, PUBLISHED 02 JANUARY 1962, ARBEIT.	1-5,12-14,17
A	US,A, 3,337,324,PUBLISHED 22 AUGUST 1967, CABLE, JR., ET AL.	8-11,18-24
A	US,A, 3,592,622, PUBLISHED 13 JULY 1971, SHEPHERD.	8-11,18-24
A	US,A, 3,592,623, PUBLISHED 13 JULY 1971, SHEPHERD.	8-11,18-24
A	US,A, 2,254,079, PUBLISHED 26 AUGUST 1941, McALPINE.	6,7,15,16
A	US,A, 3,856,496, PUBLISHED 24 DECEMBER 1974, NESBITT ET AL.	1-24
A	US,A, 3,249,417, PUBLISHED 03 MAY 1966, VAN ZONNEVELD.	1-24
A	US,A, 3,332,758, PUBLISHED 25 JULY 1967, FIRNHABER.	1-24
A	US,A, 3,523,781, PUBLISHED 11 AUGUST 1970, LEVEQUE.	1-24

* Special categories of cited documents: [15]

"A" document defining the general state of the art
"E" earlier document but published on or after the international filing date
"L" document cited for special reason other than those referred to in the other categories
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but on or after the priority date claimed
"T" later document published on or 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

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
31 DECEMBER 1981	03 FEB 1982
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Richard V. Fisher RICHARD V. FISHER

173

Form PCT/ISA/210 (second sheet) (October 1977)