Title: ADJUSTABLE MOUNTING ARRANGEMENT FOR A ROTATABLE GUIDE MEMBER

Abstract

Adjustable mounting arrangement (10) for a rotatable guide member (12) of a lift mast assembly (14) which eliminates the problems of inadvertent loosening, complexity of adjustment and premature wear. The mounting arrangement (10) includes a shaft (36) having an eccentric portion (42) upon which the rotatable guide member (12) is mounted. A cam member (78) is connected to a first end portion (38) of the shaft (36) and engageable by a mating member (86) which retains the shaft (36), at one of a plurality of incrementally rotational positions of the cam member (78) from rotational and axial movement. The mounting arrangement (10) is particularly useful in lift chain guide and side thrust roller applications.
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Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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Description

Adjustable Mounting Arrangement
For a Rotatable Guide Member

Technical Field

This invention relates to an adjustable mounting arrangement for a rotatable member and more particularly to an adjustable mounting arrangement for securing an eccentric roller assembly to a lift mast.

Background Art

Lift mast assemblies frequently utilize rollers for guiding the mast uprights, carriage and lift chains for smooth low effort operation.

When used as a guide roller, for example side thrust or fore-aft, the roller must have an adjustment provision to enable proper radial positioning of the roller relative to the upright member against which it bears.

Frequently, the guide rollers are mounted on an eccentric shaft which is in turn connected to a shaft having an axis offset from the eccentric shaft axis. This shaft in turn is connected to the carriage, when used as a side thrust roller, and rotated relative to the carriage for radial adjustment purposes. An example of such a roller assembly is shown in U.S. Patent 4,019,786 to William T. Yarris dated April 26, 1977.

Typically, assemblies of this type are secured to a carriage support member, at a selected rotational position of the eccentric shaft and retained there in an assortment of different ways. U.S. Patent 4,019,786 teaches the use of a threaded shaft, nut and washer for retention thereof, and U.S. Patent 3,467,450 to H. K.
Schmidt et al. dated september 16, 1969 teaches the use of a pair of mating tapered surfaces and a threaded fastener for retention thereof.

These methods of retention have had only limited success since they rely on friction and clamping forces which are passive retention methods. When inadvertent loosening occurs improper adjustment results which reduces the efficiency of operation of the lift mast and ultimately results in premature wear of the roller, its associated componentry and damage to the lift mast.

Lift chains are utilized in lift masts to connect a moveable member, such as a carriage or moveable upright to a fixed upright and a lift jack. Usually the chain(s) is connected at one end to the fixed upright, trained over the sheave (roller) and connected at the other end to the moveable member. Typically, one end of the chain is connected by an adjustable member to provide adjustment of the chain tension. When a pair of chains are used equalization of the length and thus the tension is highly desirable to provide smooth, quiet and efficient operation. U.S. Patents 4,280,592 to Richard J. Bartow dated July 28, 1981 and 4,238,004 to Harlan D. Olson dated December 19, 1980 teach this type of chain arrangement.

Although this arrangement prevents tension adjustment, accessibility is often poor, inadvertent loosening frequent and accurate adjustment improbable due to friction between the rotatable sheave and the chain inhibiting sliding motion thereof.

Therefore, it would be advantageous to eliminate the adjustable device at the chain end connection and provide an adjustable sheave (roller) which would permit ease of chain tension adjustment throughout its full length and positive locking of the sheave to prevent inadvertent loosening.
Disclosure of Invention

In one aspect of the present invention, an adjustable mounting arrangement for a rotatable guide member of a lift mast assembly is provided wherein the guide member is rotatably mounted on an eccentric portion of a shaft having a cam member connected thereto. The cam member has a preselected shaped profile surface defining a plurality of incremental rotational cam positions which is matingly engageable by a member at one of the plurality of incremental rotational positions for retaining the shaft at that position from rotational and axial movement.

Brief Description of the Drawings

Fig. 1 is a diagrammatic side elevational view of a lift truck and lift mast assembly showing the adjustable mounting arrangement for a rotatable chain sheave;

Fig. 2 is an exploded diagrammatic isometric view of the sheave and adjustable mounting arrangement of Fig. 1; and,

Fig. 3 is a diagrammatic cross-sectional view taken along lines III-III of Fig. 1 showing the sheave and adjustable mounting arrangement in greater detail.

Best Mode for Carrying Out the Invention

Reference to the drawings and particularly the drawing of Fig. 1 a mounting arrangement 10 for adjustable connecting a rotatable guide member 12 to a lift mast assembly 14 is shown.

The rotatable guide member 12 is depicted as a guide sheave engageable with a flexible tension member 16, such as a chain, intermediate first and second chain ends 18 and 20 for elevationally moving flexible member 16 and a moveable member 22, such as a carriage.
or moveable upright, non-adjustably connected to the first end 18 of the chain 16. In the embodiment shown the moveable member is a load engaging carriage 24 mounted on a moveable upright 26 of the lift mast. The mounting arrangement 10 is also applicable for adjustably mounting other rotatable members, such as side thrust carriage or fore-aft upright rollers.

The adjustable mounting arrangement 10 connects the rotatable guide member 12 to the moveable upright 26 at an upper end portion 28 thereof. The moveable upright is mounted on a fixed upright 30 of the lift mast assembly which is mounted on a lift truck 32 and elevationally moveable relative to the fixed upright 30 in response to extension and retraction of a lift jack 34 connected thereto. It is to be noted that the rotatable guide member may be connected at other well known locations on a lift mast, such as the lift jack or fixed upright without departing from the spirit of the invention.

Referring to Figs. 2 and 3, the adjustable mounting arrangement includes a shaft 36 having first and second cylindrical end portions 38 and 40 and a cylindrical eccentric portion 42. The first and second end portions 38 and 40 each have first and second ends 44 and 46 and a common central longitudinal axis 48. The eccentric portion 42 also has first and second ends 50 and 52 and a central longitudinal axis 54. The first end 50 of the eccentric portion 42 is connected to the second end 46 of the first end portion 38 and the second end 52 of the eccentric portion 42 is connected to the second end 46 of the second end portion 40. The longitudinal axis 54 of the eccentric portion 42 is spaced a preselected distance from and parallel to the longitudinal axis 48 of the first and second end portions 38 and 40. This spaced apart
distance of the axes establishes the amount of radial adjustment provided to the rotatable member 12, i.e., the total amount of displacement of the rotatable member 12 will be equal to twice this distance.

The rotatable guide member 12 is mounted on the eccentric portion 42 of the shaft 36 and rotatable relative thereto. The rotatable member 12 has an outer cylindrical rim 56 supported for rotation on the shaft 36 by an anti-friction bearing 58. The first end portion 38 of shaft 36 is rotatably connected to a first support member 60 and the second end portion 40 is rotatably connected to a second support member 62. The first and second support members 60 and 62 are rectangular plates mounted vertically at the upper end portion 28 of the moveable upright 26. These support members 60 and 62 are spaced apart from one another, parallel to one another, and house the rotatable member therebetween.

Each of the support members have a bore 64 disposed therethrough. The bores 64 are axially aligned and of a size sufficient to pass the shaft 36 therethrough for installation and removal thereof. A first cylindrical sheave 66, having a bore 68 and an outer cylindrical surface 69, is removably disposed in the bore 64 of the first support member 60 with the outer cylindrical surface 69 in contact with the bore 64. The first end portion 38 of the shaft 36 is rotatably supported in the bore 68 of sheave 66. The second end portion 40 of shaft 36 is rotatably supported in a bore 70 disposed in a second cylindrical sheave 72. The second sheave 72 has an outer cylindrical surface 74 which is contactly disposed in the bore 64 of second support member 62. The sheave 74 is removably affixed to the second support member by a plurality of threaded fasteners 76.
A cam member 78 has first and second ends 80 and 82 and a preselected shaped profile surface 84. The second end 82 of the cam member 78 is securely mounted on the first end portion 38 of the shaft 36 adjacent the first end 44 thereof by welding or some other equivalent fastening technique. Thus, the cam 78 and shaft 36 rotate and translate axially together as a unitary piece. The profile surface 84 defines a plurality of incrementally spaced apart rotational cam positions thereabout. The profile surface 84 is engageable by mating member 86 when the profile surface 84 is at any one of the rotational cam positions.

The mating member 86 has a flange 88 which is preferably a rectangular shaped plate. The flange 88 has first and second sides 90 and 92 and a bore 94 defining a profile surface 96 of substantially the same shape as the profile surface 84 of said cam 78.

Specifically, the cam 78 has a preselected number of equally spaced apart teeth 98 of a preselected shape and size which extend radially outwardly from and circumferentially about the cam member 78 and relative to the longitudinal axis 48 of the first end portion 38.

Likewise, the flange 88 has a plurality of equally spaced apart teeth 100 which extend inwardly from the bore 94. The teeth of the flange 88 are of a size and shape and number to matingly slidingly fit in the spaces between the teeth 98 of the cross member 78. The number of teeth on the cam 78 and flange 88 determines the number of incremental rotational positions of the shaft 36. The greater the number of teeth on the cam the finer and more precise the rotational adjustment will be. It is to be noted that other shapes for the cam 78 and flange 88 profile surfaces may be used which should be considered equivalent replacements.
The flange 88 is removeably connected to a first side 102 of the first support member 60 by a plurality of threaded fasteners 104 disposed in holes 106 in the flange 88 and screw threadably engaged in tapped holes 108 in the first support member 60. The flange is removeable so as to permit rotary motion of the shaft 36 and thus adjustment of the rotatable member 12.

A stop member 110 is connected to the flange member 88 and engageable with the first end 80 of the cam member 78. Preferably the stop member 110 is an elongated bar 112 connected to the first side of flange 88. The bar 112 passes over the bore 94 of the flange 88 so that it contacts the first end 80 of the cam member 78 when the shaft 36 is moved toward the bar 112.

As shown, the cam member 78 is sandwiched between the first side 102 of first support member 60 and the stop member 110 so that axial movement of the shaft 36 is prevented when the flange 88 is secured to the first support member 60 by fasteners 104.

Specifically, the first end 80 of cam member 78 contacts stop member 110 and the second end 82 contacts the first side 102 of flange 88 which prevents axial movement in both axial directions. Also, the eccentric portion's second end 52 is contactable with the flange 74 which additionally prevents axial movement of the shaft 36 in a direction toward the flange 74. It should be noted that the second support member 62, flange 74, and second end portion 40 may be omitted from the mounting arrangement 10. In such a case the rotatable guide member 12 is mounted in a cantilevered fashion on the first support member. This type of mounting would be particularly useful when space is restricted such as when utilized in side thrust and fore-aft roller applications.
As previously indicated, the adjustable mounting arrangement 10 is particularly useful in lift chain guide sleeve applications. Such use will permit the chain 16 to be rigidly affixed at opposite ends 18 and 20 to selected members of the lift mast assembly 14 since adjustment of chain tension will be accomplished through selective positioning of the roller.

An extension 114 is provided for rotating the shaft 36 and then adjusting the rotating member 12. The extension 114 includes a rectangular shaped bar 116 affixed to the first end 80 of cam 78, such as by welding, and connectable by a wrench or the like. The bar 116 is preferably shorter in length than the diameter of the cam 78 and bore 94, and positioned on the cam at a location so that the axis 48 of the first end portion 38 passes through the bar 16 and the bar 116 extends past the first side 90 of flange 88.

In view of the foregoing, there is provided a mounting arrangement of simple construction for adjustably connecting a rotatable member to a lift mast assembly and positively retaining the rotatable member at a preselected adjustable position.

Industrial Applicability

To adjust the position of the rotatable member 12, mating member 86 must be displaced from engagement with cam member 78 so that shaft 36 is free to rotate about its end portions 38 and 40.

The fasteners 104 are either removed or loosened a preselected amount so that the flange 88 is moveable from a second position, at which the flange 88 is in contact with the first side 102 of the first support member and the teeth 98 of the cam member 78 are engaged with the teeth 100 of the flange 88, to at
least a first position at which the flange 88 is spaced from the first side 102 and the teeth 98 are disengaged from teeth 100.

Upon movement of the flange 88 to the first position the shaft 36 is freed for rotation. A wrench or the like is then attached to the rectangular shaped bar 116 to rotate the shaft 36 about its end portions 38 and 40 and longitudinal axis 48. The shaft is then rotated a desired amount until the rotatable member 12 is properly positioned.

In the embodiment shown the proper position would be determined by the amount of tension or slack in the chain 16 desired. When two chains are utilized, the shaft 36 of each rotatable guide member is rotated until the amount of tension or slack in both chains are equal.

Upon completion of the adjustment, the flange 88 is moved into contact with the surface 102 of support member 60, with the teeth 100 of the flange 88 in mating engagement with the teeth 98 of cam member 78. The fasteners 104 are then firmly secured to retain the flange 88 securely against surface 102. It should be observed that the shaft 36 must be rotated an amount great enough to advance or retard the teeth 98 of the cam member 78 at least one tooth position relative to the flange 88 and teeth 100 to provide any change in the position of the shaft 36 and thus the rotatable member. Therefore, an adequate number of teeth 98 and 100 are provided to facilitate precise enough adjustment.

During operation of the lift mast assembly, vibratory, impact and cyclical loading is present at the rotatable guide roller 12. This loading, under normal conditions, causes loosening of the roller supporting shaft which results in premature failure as
previously discussed. This mounting arrangement 10, as described herein, alleviates this problem by positively retaining the shaft 36 from axial and rotational motion. All axial forces on the shaft 31 are directed to the support member via cam member 78 either directly or through stop member 10 and flange 88. Rotational forces and vibration acting on the shaft 36 are resisted through the positive tooth connections between the support member 60, mounted flange 88 and cam 78.

Also, the use of this radially adjustable guide roller for adjusting the tension of the lift chain permits opposite chain ends 18, 20 to be secured to the moveable member 22 and fixed member 30, respectively, without providing any adjustment at either or both of the ends. As a result the chain tension adjustment will be quick, easy, and accurate.

Other aspects, objects and advantages of the invention can be obtained from a study of the drawings, disclosure, and appended claims.
Claims

1. An adjustable mounting arrangement (10) for a rotatable guide member (12) of a lift mast assembly (14), comprising:
   a shaft (36) having a first cylindrical end portion (38) and a cylindrical eccentric portion (42), said first end portion (38) having first and second ends (44, 46) and a longitudinal axis (48), and said eccentric portion (42) having first and second ends (50, 52) and a central longitudinal axis (54), said eccentric portion (42) first end (50) being connected to the second end (46) of the first end portion (38) and said longitudinal axis (54) of the eccentric portion (42) being offset relative to the longitudinal axis (48) of the first end portion (38), said rotatable guide member (12) being mounted on said eccentric portion (42) and rotatable relative thereto;
   a first support member (60), said shaft (36) first end portion (38) being connected to the first support member (60) and axially and rotatably movable relative thereto;
   a cam member (78) having a preselected shaped cam profile surface (84) and being mounted on the first end (44) of said shaft first end portion (38) and rotatably and axially movable with said shaft (36), said cam profile surface (84) defining a plurality of incrementally rotational cam positions; and,
   means (86) for matingly engaging said cam profile surface (84), in response to said cam surface being at one of said plurality of incremental rotational positions and positively retaining said shaft (36) at said one position from rotational and axial movement.
2. The adjustable mounting arrangement (10), as set forth in claim 1, wherein said engaging means (86) includes:

- a flange (88) connected to said first support member (60) and contactably engaged with said cam profile surface (84).

3. The adjustable mounting arrangement (10), as set forth in claim 2, wherein said cam profile surface (84) is radially spaced from and circumferentially disposed about the axis (48) of said shaft and first end portion (38), said flange (88) having a bore (94) disposed therein, said bore (94) defining a preselected shaped profile surface (96), said bore profile surface (96) having substantially the same shape as the cam profile surface (84), said cam member (78) being slidably disposed in said flange bore (94) and said cam profile surface (84) being contactably engaged with said bore profile surface (96).

4. The adjustable mounting arrangement (10), as set forth in claim 3, wherein said cam profile surface (84) includes a plurality of equally spaced apart teeth (98), extending radially outwardly from said cam member (78) and relative to the axis (48) of said shaft first end portion (38), said bore profile surface (96) defines a plurality of equally spaced apart teeth (100) extending radially inwardly from said bore (94) and towards the axis (48) of said shaft first end portion (38), said flange teeth (100) being matingly engageable with said cam teeth (98).

5. The adjustable mounting arrangement (10), as set forth in claim 3, wherein said flange (88) is movable between a first position, at which said flange
(88) is spaced from said first support member (60) and said cam member (78) is free from contacting said bore profile surface (96), and a second position, at which said flange (88) is contactable with said first support member (60) and said cam member (78) is contactable with said bore profile surface (96).

6. The adjustable mounting arrangement (10), as set forth in claim 5, wherein said engaging means (86) includes:

fastening means (104,106,108) for releasably connecting said flange member (88) to said first support member (60) at the second position of said flange member (88).

7. The adjustable mounting arrangement (10), as set forth in claim 6, wherein said fastening means (104,106,108) includes:

a plurality of threaded fasteners (104) each being disposed in an aperture (106) in said flange (88) and connected to said first support member (60).

8. The adjustable mounting arrangement (10), as set forth in claim 3, wherein said cam member (78) has a first end (80) and said engaging means (86) includes:

a stop member (110) connected to said flange member (88) and engageable with the first end (80) of said cam member (78).

9. The adjustable mounting arrangement (10), as set forth in claim 8, wherein said flange member (88) has a side (90) and said stop member (110) is an elongated bar (112), said elongated bar (112) being connected to said flange side (90) and in an overlapping relationship with said bore (94).
10. The adjustable mounting arrangement (10), as set forth in claim 8, wherein said cam member (78) has a second end (82) and said first support member (60) has a first side (102) and a bore (64) disposed therethrough, said shaft first end portion (38) being rotatably supportingly disposed in said bore (64) and said cam member (78) being located between the first side (102) of said first support member (60) and said stop member (110), said cam member second end (82) being contactably engaged with the first side (102) of said first support member (60).

11. The adjustable mounting arrangement (10), as set forth in claim 10, wherein said shaft (36) has a cylindrical second end portion (40) axially aligned with the first end portion and connected to the second end (52) of said eccentric portion (42) and including:
   a second support member (62) having a bore (64) disposed therein, said shaft second end portion (40) being rotatably supportingly disposed in the bore (64) of said second support member (62), and said eccentric portion (42) being located between said first and second support members (60,62).

12. The adjustable mounting arrangement (10), as set forth in claim 11, including:
   first and second sleeve members (66,72) each having a cylindrical bore (68,70) and an outer cylindrical surface (69,74), said first sleeve (66) being disposed in the bore (64) of the first support member (60) and said second sleeve (72) being disposed in the bore (64) of said second support member (62), said shaft first end portion (38) being disposed in the bore (66) of said first sleeve (66) and rotatable relative thereto and, said shaft second end portion (40) being disposed in the bore (70) of said second sleeve (72) and rotatable relative thereto.
13. The adjustable mounting arrangement (10), as set forth in claim 10, wherein the bore (64) of said first support member (60) is of a size sufficient to pass the eccentric portion (42) of said shaft (36) therethrough.

14. The adjustable mounting arrangement (10), as set forth in claim 8, including:

means (114) for rotating said shaft (36) about the longitudinal axis (48) of said first end portion (38) and positioning said cam surface (84) at a selected one of said incremental rotational positions.

15. The adjustable mounting arrangement (10), as set forth in claim 14, wherein said rotating means (114) includes:

a rectangular shaped bar (116) connected to the first end (80) of said cam member (78).

16. The adjustable mounting arrangement (10), as set forth in claim 4, wherein said lift mast assembly includes a flexible tension member (16), said flexible tension member being trained over said rotatable guide member (12) and contactably guided thereby.

17. In a lift mast assembly (14) having a fixed member (30) and an elevationally movable member (22), a rotatable sheave (12) and a flexible tension member (16) having opposite ends (18, 20), said flexible member (16) being trained over said sheave (12) and connected at one end (20) to the fixed member (30) and at the other end (18) to the movable member (22), the improvement comprising:
a shaft (36) having a cylindrical first and second end portion (38,40) and a cylindrical eccentric portion (42), said first and second end portions (38,40) having a common central longitudinal axis (48) and said eccentric portion (42) having a central longitudinal axis (54), said eccentric portion longitudinal axis (54) being parallel to and spaced from the longitudinal axis (48) of said end portions (38,40), said sheave (12) being rotatably mounted on said eccentric portion (42);

first and second support members (60,62), said support members (60,62) being connected to one of said fixed (30) and movable (22) members and said first and second shaft end portions (38,40) being rotatably connected to said first and second support members (60,62), respectively;

a cam member (78) having a plurality of spaced apart teeth (98) and being connected to the first end portion (38) of said shaft (36), each of said teeth defining an incremental rotational shaft position; and,

means (86) for matingly engaging the teeth (98) of said cam member (78) at a selected one of said incremental rotational positions of said shaft (36) and retaining said cam member (78) and said shaft (36) from rotational and axial movement.

18. The lift mast assembly (14), as set forth in claim 17, wherein said engaging means includes:

a flange (88) having a bore (94), a side (90) and a plurality of spaced apart teeth (100) projecting inwardly from said bore (94), said flange (88) being removably connected to said first support member (60); and,

a stop (110) connected to the side (90) of said flange (88) and passing said bore (94) in an overlapping fashion, said stop (110) being engageable with said cam member (78).
19. The lift mast assembly (14), as set forth in claim 18, including:
   means (114) for rotating said shaft (36) about the first and second end portion longitudinal axis (48) and positioning said cam member (78) at a selected location at which the teeth (98) of the cam member (78) and the flange (88) are aligned for mating engagement.

20. The lift mast assembly (14), as set forth in claim 19, wherein said cam member (78) has a first end (80) and said rotating means (114) includes:
   a bar (116) having a rectangular shape and being connected to the first end (80) of said cam member (78).

21. The lift mast assembly (14), as set forth in claim 17, wherein said flexible tension member (16) is adjustably movable relative to the ends (18, 20) of the chain in response to rotation of said shaft (36).
## INTERNATIONAL SEARCH REPORT

**I. CLASSIFICATION OF SUBJECT MATTER**
According to International Patent Classification (IPC) or to both National Classification and IPC

| US CL. | 474/112 | 187/9E |
| INT. CL. | F16H 7/12 | B66B 9/20 |

**II. FIELDS SEARCHED**

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

**III. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>US 1,657,024 Published 24 January 1928, See Fig. 1 (Morse)</td>
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<td>US 1,206,538 Published 28 November 1916, See Fig. 2 (Howe)</td>
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<td>A</td>
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<td>A</td>
<td>US 4,306,466 Published 22 December 1981, See Fig. 3 (Coveney)</td>
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<td>US 1,171,347 Published 08 February 1916 (Morse)</td>
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<td>A</td>
<td>US 3,467,450 Published 16 September 1969, Schmidt et al See Fig. 2</td>
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<td>US 4,238,004 Published 9 December 1980, Olson See second sheet</td>
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* Special categories of cited documents:
  * A document defining the general state of the art which is not considered to be of particular relevance
  * E document not 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
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  * T 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
  * Z document member of the same patent family

**IV. CERTIFICATION**

Date of the Actual Completion of the International Search: 14 February 1983
Date of Mailing of this International Search Report: 01 March 1983

International Searching Authority: ISA/US

Signature of Authorized Officer:

Stuart S. Levy
### Further Information Continued from the Second Sheet

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<td>Y</td>
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### Observations Where Certain Claims Were Found Unsearchable

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 matter 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 out, specifically:

### Observations Where Unity of Invention Is Lacking

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.