PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
G11B 15/665	A1	WO 92/22897
		(43) International Publication Date: 23 December 1992 (23.12.92)

(21) International Application Number: PCT/US92/04846

(22) International Filing Date: 9 June 1992 (09.06.92)

(30) Priority data:
712,795 10 June 1991 (10.06.91) US

(71) Applicant: DATATAPE INCORPORATED [US/US]; 360 Sierra Madre Villa, Pasadena, CA 91109-7014 (US).

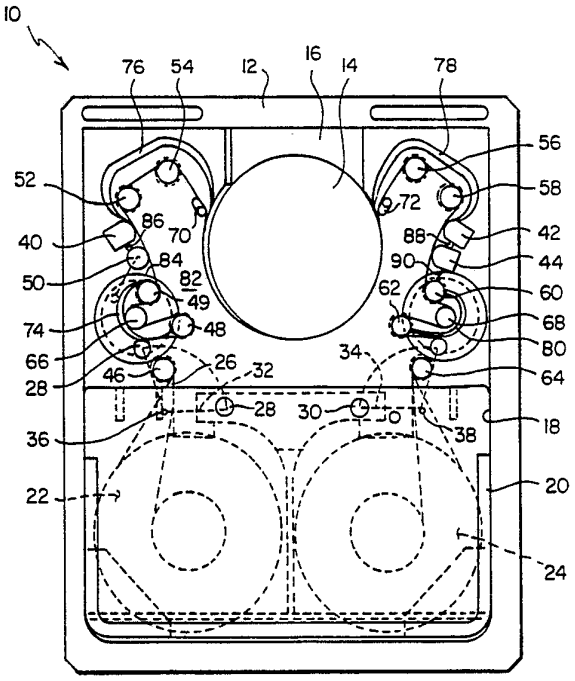
(72) Inventors: PIARULLI, Vincent, James ; 3039 Sioux Court, Simi VAlley, CA 93063 (US). GRANT, Frederic, F. ; 14505 Eastbrook Avenue, Bellflower, CA 90706 (US). COLE, Kevin, A. ; 624 Haley Road, Ontario, NY 14519 (US). GRANT, John, Phillip ; 11937 Rives, Downey, CA 90242 (US).

(74) Agents: NOVEL, William, F. et al.; 343 State Street, Rochester, NY 14650-2201 (US).

(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent).

Published
With international search report.

(54) Title: MAGNETIC TAPE THREADING AND GUIDING SYSTEM FOR A HELICAL SCAN RECORDER



(57) Abstract

A helical scan magnetic tape recorder has a magnetic tape threading and guiding system. Magnetic tape (26) contained in a cassette (20) is extracted from the cassette (20) and threaded around a magnetic tape path past a helical scan magnetic head assembly (14) by means of a pneumatic threading arrangement (74, 76, 78, 80). Tape threading is fast and gentle with no stress or edge damage to the tape. The threading arrangement has relatively few moving parts and is simple and reliable in design. After the tape is threaded into the tape transport, a plurality of tape guide elements (52, 54, 56, 58, 66, 70, 72, 80) mounted on a precision platform (100) are moved into position behind the magnetic tape (26). Thereafter, the pneumatic threading vacuum is terminated and the magnetic tape (26) is tensioned around the guide elements (52, 54, 56, 58, 66, 70, 72, 80) which establish a low constraint tape path about several stationary magnetic head assemblies (40, 42, 44) and a helical scan head assembly (14).

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	FI	Finland	ML	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IE	Ireland	RO	Romania
CA	Canada	IT	Italy	RU	Russian Federation
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland			SN	Senegal
CI	Côte d'Ivoire	KR	Republic of Korea	SU	Soviet Union
CM	Cameroon	LI	Liechtenstein	TD	Chad
CS	Czechoslovakia	LK	Sri Lanka	TG	Togo
DE	Germany	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		
ES	Spain	MG	Madagascar		

MAGNETIC TAPE THREADING AND GUIDING SYSTEM FOR A HELICAL SCAN RECORDER

Technical Field

This invention relates in general to magnetic tape recording/reproducing apparatus and more particularly to a magnetic tape threading and guiding system for use in a helical scan magnetic tape recorder/player.

Background Art

Various techniques have been proposed for use in magnetic tape recorder/players for threading magnetic tape from a cassette into a tape transport path and for guiding the tape along such path. Both manual and automatic mechanical arrangements have been proposed for threading magnetic tape from a cassette. Such mechanical arrangements involve mechanical guide elements and linkages which extract a length of magnetic tape from a cassette and which move the tape to a final tape transport path. The path is defined by the guide elements and includes one or more magnetic heads. The mechanical arrangement must then provide for guiding the tape during transport past the magnetic head. Both the tape threading operation and the tape transport operation typically requires some components of the overall mechanism to be employed in one operation but not in the other operation. For example, one or more motors and associated linkages may be used for a tape threading operation but play no part in the tape transport operation. During threading operation, the various linkages and guide elements are moved over considerable distances and must be accurately located to establish a tape guide path which permits accurate recording and playback of information on the magnetic tape. Purely mechanical tape threading mechanisms are both expensive and complex and tape threading and

unthreading is relatively time consuming. The following patents are illustrative of mechanical tape threading and guiding arrangements: U.S. Patent 3,674,942, issued July 4, 1972, Inventors Sugaya et al.; U.S. Patent 4,259,700, issued March 31, 1981, Inventors Galue et al.; U.S. Patent 4,642,706, issued February 10, 1987, Inventors Vollmann et al.; U.S. Patent 4,541,024, issued September 10, 1985, Inventor Sieven; and U.S. Patent 3,678,217, issued July 18, 1972, Inventor Kihara.

In order to ameliorate the problems associated with mechanical threading arrangements for magnetic tape recorders, various techniques have been proposed for pneumatically threading magnetic tape into a magnetic tape recorder from a cassette or cartridge. Thus, U.S. Patent 4,620,678, issued November 4, 1986, Inventors Kumakura et al. discloses a cartridge loading system wherein magnetic tape contained in a single reel cartridge is threaded into a transport mechanism having a take-up reel. Threading is effected by means of air streams which carry a leading end portion of the magnetic tape from an open supply reel via a channel to a take-up reel until the leading end portion is wound around the take-up reel hub. U.S. Patents 4,413,293, issued November 1, 1983, Inventor Hathaway; U.S. Patent 3,940,791, issued February 24, 1976, Inventors Kayan et al. and IBM Technical Disclosure Bulletin, Volume 12, Number 6, pp. 808 and 809, dated November 19, 1969, disclose arrangements for automatically threading tape contained in a two-reel cassette into a magnetic tape transport containing a helical scan magnetic head assembly or the like. The pneumatic threading arrangements disclosed in the former two patents are disadvantageous because the individually movable guide elements disclosed in these references are complex and subject to reliability problems.

Besides effecting threading of magnetic tape into a magnetic tape recorder transport path, various arrangements have been proposed for using vacuum columns and the like to effect control of magnetic tape as it is transported along a path from one reel to another. Such vacuum column arrangements are disclosed, for example, in U.S. Patent 3, 134,527, issued May 26, 1964, Inventor Willis; U.S. patent 3,134,528, issued May 26, 1964, Inventor Vickey; U.S. Patent 2,952,010, September 6, 1960, Inventors Vemer et al. A combined pneumatic threading and guiding arrangement is disclosed in commonly assigned U.S. Patent 4,779,150, issued October 18, 1988, Inventor Grant; U.S. Patent 4,772,969, issued September 10, 1988, Inventor Grant; and U.S. Patent 4,763,210, issued August 9, 1988, Inventor Grant. The arrangements disclosed in the latter three patents require the application of a vacuum during both the threading and tape transport operations.

There is thus a need for a tape threading and guiding system for a helical scan tape recorder which is simple and reliable and which effects threading in a fast and gentle manner while minimizing stress or edge damage to the tape. There is also a need for a tape guiding system which establishes a low constraint tape path between supply and take-up reels past a helical scan magnetic head assembly.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a magnetic tape threading and guiding system which obviates the disadvantages of known magnetic tape threading and guiding techniques. According to an aspect of the present invention, magnetic tape contained in a cassette is threaded from the cassette into a tape transport path of a magnetic tape recorder/player in a fast but gentle manner so that stress or edge damage to the tape is avoided. The tape

threading mechanism is a simple and reliable structure with few parts. According to an aspect of the present invention, a magnetic tape threading and guiding system is provided for use in a helical scan magnetic tape recorder/player. The system includes several vacuum ports which are sequentially actuated to pull magnetic tape from a magnetic tape cassette to form a path around a helical scan magnetic head assembly and several stationary magnetic heads.

According to another aspect of the present invention, a plurality of tape guide elements are mounted on a movable precision plate which hold the elements out of the tape path during threading. After the tape is pulled past the guide element locations the guide plate is moved to position the guide elements to establish a tape transport path for accurately guiding magnetic tape past the magnetic head assemblies.

According to another feature of the present invention the guide elements located along the transport path are configured to effect a low constraint path to minimize tape wear and damage.

BRIEF DESCRIPTION OF THE DRAWINGS

In a detailed description of the preferred embodiments of the invention presented below, reference is made to the accompanying drawings in which like numerals refer to like elements.

Fig. 1 is a diagrammatic plan view of a helical scan magnetic tape recorder/player including an embodiment of the present invention.

Figs. 2, 3, 4 and 5 are diagrammatic plan views useful in describing the operation of the embodiment of Fig. 1.

Figs. 6-10 are diagrammatic perspective views also useful in describing the operation of the embodiment of Fig. 1.

Figs. 11 and 12 are respectively bottom plan and side elevational views of the movable tape guide element assembly.

Figs. 13 and 14 are diagrammatic views of alternate pneumatic threading arrangements useful in the present invention.

Figs. 15 and 16 are diagrammatic plan views illustrating another embodiment of the present invention.

Fig. 17 is a partially sectional, elevational view of a guide element which is used in the embodiment of Fig. 15.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a description of preferred embodiments of the present invention described below, reference will be made to a helical scan magnetic tape recorder/reproducer. It will be appreciated, however, by those skilled in the art that the threading and guiding system of the present invention is also applicable to other web handling systems such as optical media tape systems and the like. Referring now to Fig. 1, there is shown a helical scan magnetic tape recorder 10 having a housing 12 which mounts rotary head scanner 14 mounted on scanner carrier 16. Housing 12 has a magnetic tape cassette receiving station 18 which supports magnetic tape cassette 20. Cassette 20 includes reels 22 and 24 about which magnetic tape 26 is wound.

Recorder 10 includes compliance rollers 28 and 30 mounted at the ends of respective arms 32 and 34 for pivotal rotation about pivots 36 and 38. Magnetic tape 26 is guided around a tape transport path past stationary magnetic heads 40, 42 and 44 and rotary head scanner 14. The transport path includes a plurality of guide rollers 46, 48, 50, 52, 54, 56, 58, 60, 62, and 64. Tape is transported along the path by means of capstans 66 and 68.

Stationary guide posts 70 and 72 are tilted in opposite directions to establish a helical angle of wrap of tape 26 about rotary head scanner 14 which is also tilted.

According to a feature of the present invention, tape is threaded from cassette 20 by means of a hybrid pneumatic and mechanical system. Recorder 10 is provided with vacuum cavities 74, 76, 78 and 80 which are attached to a source of vacuum (not shown). Bottom walls 82, a top wall (not shown) and side walls 84, 86, 88 and 90 cooperate with cavities 74, 76, 78 and 80 to define a vacuum region used in pneumatically threading magnetic tape 26 from cassette 20.

Referring now to Figs. 2, 3, 4 and 5, there will be described the operation of the present invention in the threading mode. When cassette 20 is inserted into recorder 10, the magnetic tape 26 is entirely contained within cassette 20 and includes a span shown by arrow A which extends between reels 22 and 24 over guides 92 and 94 of cassette 20 (See Figs. 2 and 6).

When cassette 20 is properly positioned in recorder 10, compliance guide rollers 28 and 30 are retracted and extend into opening 96 in the lower wall of cassette 20. The threading operation is initiated by rotating compliance arms 32 and 34 in opposite directions to draw tape 26 out of cassette 20 to a position shown by arrow B (Fig.s 2, 7). Rollers 28 and 30 are pivoted to positions 28A and 30A to wrap tape 26 about tape rollers 46 and 64 which are so located that tape 26 does not contact any structure of cassette 20 except reels 22 and 24.

Pneumatic threading is effected by applying vacuum to cavities 74, 76, 78 and 80. Magnetic tape 26 is servo controlled at low tension and is vacuum drawn into the vacuum region to gently wrap tape 26 about rotary head scanner 14 and guide rollers 48 and 62 to

the position shown by arrows C (Figs. 3, 8). The vacuum continues to draw tape 26 to the position shown by arrows D where tape 26 contacts rollers 49, 50 and 60 and stationary head 44. When tape 26 is drawn to the positions shown at arrows E, it contacts magnetic heads 40, 42, wraps further about scanner 16, and contacts vacuum cavities 74 and 80.

Referring to Fig. 4, the tape 26 is shown nested into the vacuum recesses formed by vacuum cavities 74, 76, 78 and 80. Tape 26 is also wrapped on elements 46, 28, 48, 49, 50 and 40 on the supply reel 22 side, on the rotary head scanner 14 and on elements 64, 30, 62, 60, 42 and 44 on the take-up reel 24 side.

In response to a signal that the tape 26 is in place in the vacuum recesses, a mounting platform 100 (Figs. 11 and 12), that is parallel to the floor 102, is moved toward the floor 102 in the direction of arrow 104. Platform 100 extends elements 66, 52, 54, 70, 72, 56, 58 and 80 through ports 106A, 106B,...,106H in the top cover 108 and into alignment with the tape path. The platform 100 stops against three points (not shown) so that the carried tape guide elements are in precise vertical position and their axes are in precise position for desired tape tracking.

When the platform 100 has lowered elements 66, etc. into place, the tape tension is increased to pull the tape into engagement with them (Figs. 5 and 10). These elements are chosen such that they can guide the tape throughout the tape path with little or no unbalance in tension or tendency to bend the tape from its path. The tape path guiding elements achieve very gentle, minimum stress, tape handling. The tilted posts 70 and 72 adjacent to the scanner 14 do not constrain the tape in angular relation to its travel or laterally since the tape slides over them and is free to position itself. The rollers 52 and 58 are shown in Fig. 17 and are of a type similar to the one described

in commonly assigned U.S. Patent 4,403,720 which is omnidirectionally pivoted near its center such that it causes the tape 26 to be urged lightly against the bottom edge guide 110. This guide 110 differs from the one described in U.S. Patent 4,403,720 in that the ceramic edge surface to contact the tape edge is mounted to the floor 102 to precisely locate it and the roller 52 (58) comes down into juxtaposition to it. The guides 54 and 56 will be either the same as guides 52 and 58 or they may be similar to the guide described in commonly assigned U.S. Patent 4,573,619, in which case the movable ceramic will be mounted from the floor 102. In each case, the guides will not need to have the tape retainer shown in the patent because the tape 26 is adequately retained by the floor 102, the cover 108 and the vacuum chamber walls.

In the case where the ceramic edge of guides 54 and 56 is adjusted it can be for two purposes. First, it may be an automatic system which simultaneously adjusts guides 54 and 56 in opposite directions to correct for tracking errors. Secondly, the guides 54 and 56 may be changed to accommodate a change in the number of magnetic heads, by altering the helix angle of the tape 26 on the scanner 14. Thus, the recording angle on the tape 26 will maintain the same pattern on the tape 26 as the tape to scanner speed increases to accommodate more heads or decreases to accommodate fewer heads. For example, the change in ceramic edge positions may each change .0035 inch to accommodate a change from two to eight record heads. In the event of such a change, the two pairs of guides 52 and 54 and 56 and 58 will adjust automatically to accommodate the slight slope in the tape path relative to the floor 102. Also, guides 70 and 72, if they are pivotally mounted, would change their tilt very slightly to adjust to the .0035 inch change in the tape path at guides 54 and 56.

The stationary magnetic heads 40, 42 and 44 and the tape sensor 50 are all non-rotating elements and allow the tape to seek its natural lateral position and exercise no angular control on the tape. The guides 49 and 60 are gimbal guides with an axially compliant cover. The gimbal axes are in the directions 112 and 114 shown in Fig. 4 and at the height from the base to the center of the tape width. The axial compliance is provided by an elastomer covering with peripheral grooves in the elastomer - the grooves and lands being of about equal width. There is also an edge guide reference on both rollers 49, 60 actuated by the rotation of the adjacent capstan 66, 48 through a device like a sealed bearing or greased bearing that takes some torque from the capstan to swing the guide edge in and out of position. The edge guide surface contacts the bottom tape edge in forward tape direction (from reel 22 to reel 24) on guide 60 and in reverse tape direction (from reel 24 to reel 22) on guide 49 so that the guide guides the tape as it moves toward the cassette 20 but not when it is moving away from the cassette 20.

The capstans 66 and 68 have a high friction urethane compound coating and operate at slight differential speeds so that they add tension to the tape in both directions of travel.

Guides 48 and 62 are not gimbal guides but are made axially compliant in the same way as guides 49 and 60. Also the compliance arm rollers 28 and 30 are axially compliant elastomer coated rollers. They serve the dual purpose of serving as swing out rollers to withdraw the tape 26 from the cassette 20 under motor control and then with the arms in position they serve as compliance rollers to control the reels by imputing tension information to the reel motor servos. Like the rollers 49 and 60 the rollers 46 and 64 are gimbal rollers with axially compliant surfaces. The gimbal

axes 116 and 118 are as shown in Fig. 4. These rollers do not have edge guiding.

Alternate pneumatic threading arrangements are shown in Figs. 13 and 14. As shown in Fig. 13 a vacuum wall 120 with longitudinal grooves 121 located adjacent to scanner 14, includes a vacuum vent pipe 122. In order to control the tape 26 to go to region 124 first and then to go to region 126, the vacuum vent 122 is placed at region 124. When the tape 26 is drawn into contact with the wall 120 in region 124, it acts as a valve so that the vacuum becomes effective along the grooves 121 on the inside of the wall 120 and along the space between the wall 120 and tape 26 to draw the tape 26 against the wall in region 126.

This threading sequence is desirable due to the fact that the tape 26 enters the area of regions 124 and 126 from the unspooling reel 22 in the cassette 20 (Fig. 1) in the directions of arrows 128. If the tape 26 were first to contact the wall 120 in region 126 (as it would if it were connected directly to vacuum), then the friction against the wall 120 in region 126 would prevent tape 26 from being drawn into region 124.

There is an identically symmetrical system on the other side of the scanner 14 to cooperate in wrapping the tape 26 on the scanner 14.

Referring now to Fig. 14, there is shown an arrangement useful when a head 130 or some other item requires a specific discontinuity in the curvature of the vacuum wall 132 so that the tape 26 may still be drawn sequentially into region 134 and region 136. As the tape 26 contacts the head 130 or other item in this location the vacuum action is cut off from region 136 and confined to region 134. Thus, the tape 26 then will cover the pipe 138 and short grooves and act as a valve to separate the vacuum from the space of region 134 so that its effect will be felt through the

connecting pipe 140 of region 136. Thus, after the tape 26 is in place against the wall 132 in region 134 it will then be pulled into contact with the wall 132 in region 136. It is evident that a valving action could be built into the wall in region 136 also in the event there was another region to subsequently load.

A similar loading method (like the ones shown in Fig. 13 or Fig. 14) will be in effect on the opposite side of the scanner 14.

The tape threading sequence of Fig. 14 or that of Fig. 13 takes place prior to lowering or raising the guiding elements in regions 136 and 134. In the instance of raising the guiding elements out of the tape path, the tape 26 starts from within the regions 134 and 136.

Referring now to Figs. 15 and 16 there is shown another embodiment of the present invention. A frame 140 has a D-1 type cassette 142 which contains a first reel 143 and a second reel 144. A strand of tape 26 goes from a right hand spiral on reel 143 to a left hand spiral on reel 142. On the frame 140, all the tape guiding elements from reel 143 along the tape path segment 162 to the tilted guide 156 are in the same plane as the tape wound on reel 143. From the second tilted guide 157 along the tape path segment 163 all the guide elements are in the same plane as the tape on tape reel 144.

The tilt and angle of the guides 156 and 157 is calculated to give just the right wrap, twist and direction change to accommodate the tape path changes before and after the scanner 151. Due consideration is given to the facts that scanner 151 leans (12° to the right as shown) and that the tape 26 contacts the scanner 151 on a helical path of more than five degrees.

The rollers 154 and 155 are located so that the tape 26 does not contact any part of the cassette

142 except the reels 143 and 144 regardless of the amount of tape on reels 143 and 144. Rollers 154 and 155 are gimbal rollers of the type described in commonly assigned U.S. patent 4,403,720 (Fig. 17). The tape 26 tends to ride against the edge guiding reference 110 at the bottom, as the roller 154, 155 aligns itself to the tape path without undue tape stress as might occur with a slightly out of line roller with a fixed axis. The movable rollers 145 and 146 withdraw the tape from the cassette 142 and assist in the tape threading operation and function as compliance rollers in their extended position (Fig. 15 - Rollers 145 and 146 move from positions 145A and 146A to 145B and 146B to 145C and 146C). Rollers 145 and 146 are positioned as precisely perpendicular to the frame 140 as possible.

The capstans 152 and 153 are also cylindrical and are precisely perpendicular to the frame 140. Hence, the most constrained section of the tape path on each side of the scanner 151 is the short section between roller 145 and capstan 152 on the supply side and between roller 146 and capstan 153 on the normal take up side. This holds true for either direction of tape travel.

The fixed magnetic heads 164 do not tend to over constrain the tape 26 because the tape 26 slides continuously on them whenever the tape 26 moves. In effect, this makes the lateral friction on the heads 164 zero, since the tape 26 can readily have a vertical component (lateral to the tape) of its motion.

The rollers 158 and 160 on the supply side and rollers 159 and 161 on the take up side are also the gimbal type described in U.S. Patent 4,403,720 (Fig. 17). Thus, the only constraint on the tape 26 is the tendency for it to guide downward on each roller and have a higher lower edge tension. Even when guides 156 and 154 on the scanner mount are not at exactly the

same level as guides 158 and 159 on the frame 140, the guides are able to tilt slightly and accommodate the small out of level situations. This is enhanced by the fact that the tape path turns 90° on each of guides 158, 159, 160 and 161. Thus, if a guide is tilted by the tape 26 to accommodate a slight out of level condition, due to the 90° bend, the tape 26 is simply twisted very slightly in the next strand to accommodate the tilt.

The tape 26 slides on the posts 156 and 157 so that they do not constrain the tape 26, but let it slide up or down (lateral to the tape path). The posts 156 and 157 are positioned according to very careful calculation. They are also mounted so that, during a calibration procedure, they can be adjusted to fine tune the tape guiding, while a master calibration tape is played back with the played back signal displayed on an oscilloscope.

The over constraint on the tape between the compliance roller 145 and capstan 152 and between compliance roller 146 and capstan 153 is diminished by the fact that the compliance rollers 145 and 146 are adjustable and are adjusted in assembly to be parallel to their respective adjacent capstans.

Industrial Applicability

The magnetic tape threading and guiding system has industrial applicability in the information and video imaging industries in which analog or digital information, data or images are recorded, stored and played back by helical scan magnetic tape recorders.

What is claimed is:

1. In a magnetic tape handling apparatus including means for receiving a cassette with first and second rotatably mounted reels supporting a tape with a span extending between said reels and a rotary head scanner, threading and guiding system comprising:

means for guiding a tape along a path between first and second reels of a received cassette and past said rotary head scanner, said guiding means including a first set of guide elements which are in a fixed location along said path and a second set of guide elements which are mounted for simultaneous movement into and out of said path;

vacuum means operable (a) in a threading mode for creating a vacuum which acts on said tape to form a tape loop outside of said cassette so that said tape comes into contact with said first set of guide elements and with said rotary head scanner, and (b) in a tape transport mode when no vacuum is created, after said second set of guide elements have been moved into positions along said tape path, wherein said tape path is substantially defined by said first and second sets of guide elements and said rotary head scanner.

2. The system of claim 1 wherein said second set of guide elements are mounted for movement perpendicularly to said tape path.

3. The system of claim 1 wherein said second set of guide elements include at least one gimballed roller on opposite sides of said rotary head scanner.

4. The system of claim 1 wherein said first and second sets of guide elements establish a low constraint tape path for tape transported between said first and second reels past said rotary head scanner.

5. The system of claim 1 wherein said vacuum means includes first and second vacuum cavities spaced from and located on opposite sides of said

rotary head scanner and including compliance roller threading means for initially removing tape from a received cassette and establishing a first tape loop outside of said cassette and wherein after said first loop is formed, said first and second vacuum cavities draw said tape further out of said cassette to form said loop in contact with said first set of guide elements and with said rotary head scanner.

6. The system of claim 5 wherein said first and second vacuum cavities are concave and have inner grooved walls having a vacuum outlet at ends of said cavities nearest said rotary head scanner such that said tape is initially drawn to said vacuum outlets and then to regions remote from said vacuum outlets.

7. The system of claim 5 wherein said first and second vacuum cavities have a centrally located discontinuity and near and far vacuum regions on respective sides of said discontinuity and wherein said tape is initially drawn into said near vacuum regions and then into said far vacuum regions.

8. The system of claim 5 wherein said first and second set of guide elements establish a low constraint tape path for tape transported between said first and second reels past said rotary head scanner.

9. The system of claim 8 wherein said second set of guide elements include respective gimballed guide rollers located on opposite sides of said rotary head scanner.

10. The system of claim 8 wherein said second set of guide elements include respective sets of gimballed guide rollers located on opposite sides of said rotary head scanner.

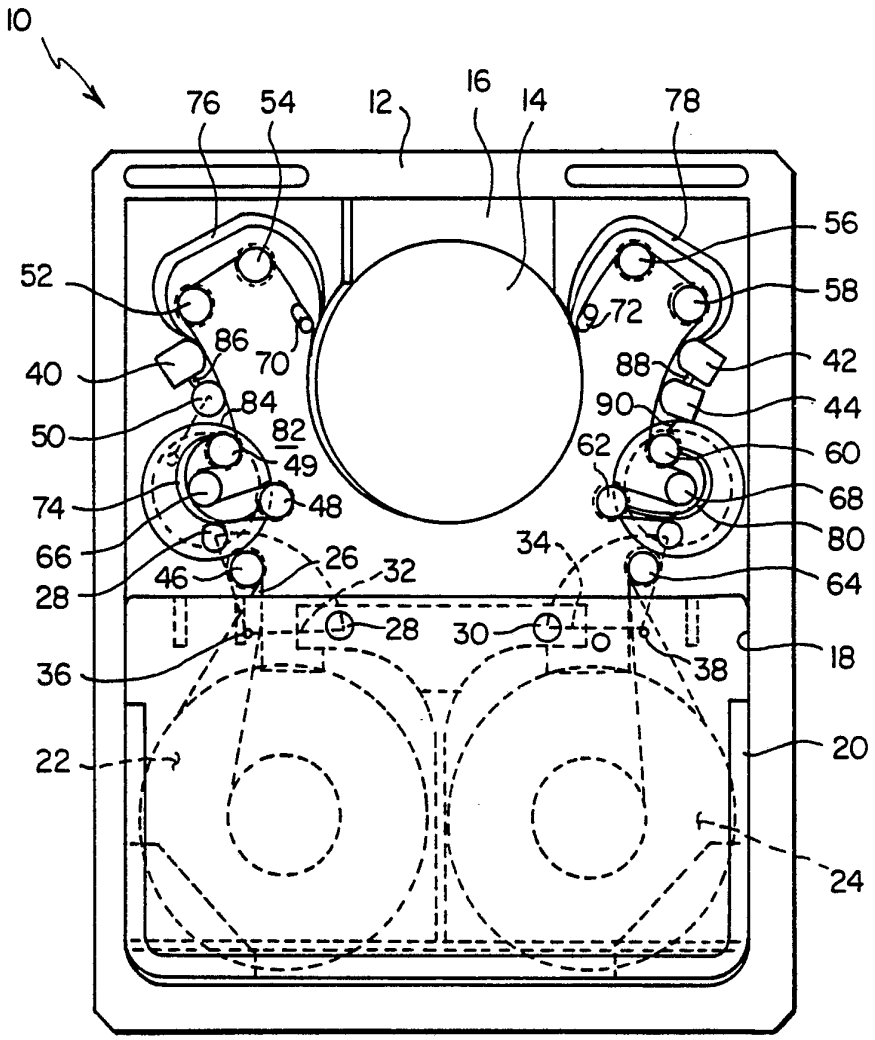

10
76
54
12
16
14
78
56
52
58
72
86
70
88
42
40
84
90
44
50
82
62
60
49
74
48
68
66
34
80
26
32
46
28
64
28
30
18
36
38
22
20
24

FIG. 1

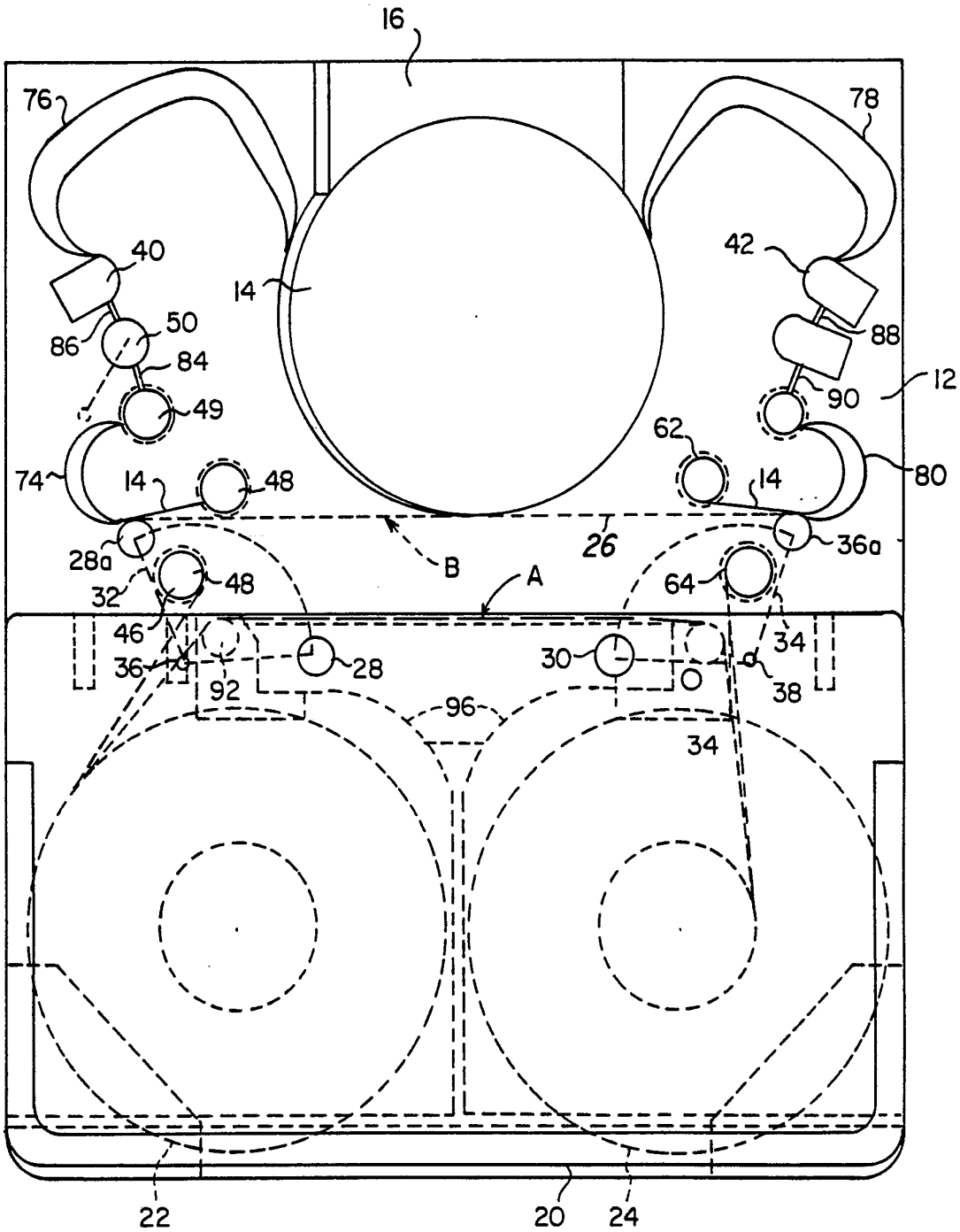

16
76
78
40
42
14
50
86
84
88
90
12
49
62
74
14
48
14
80
28a
B
26
36a
32
48
A
64
46
34
36
28
30
38
92
96
34
22
20
24

FIG. 2

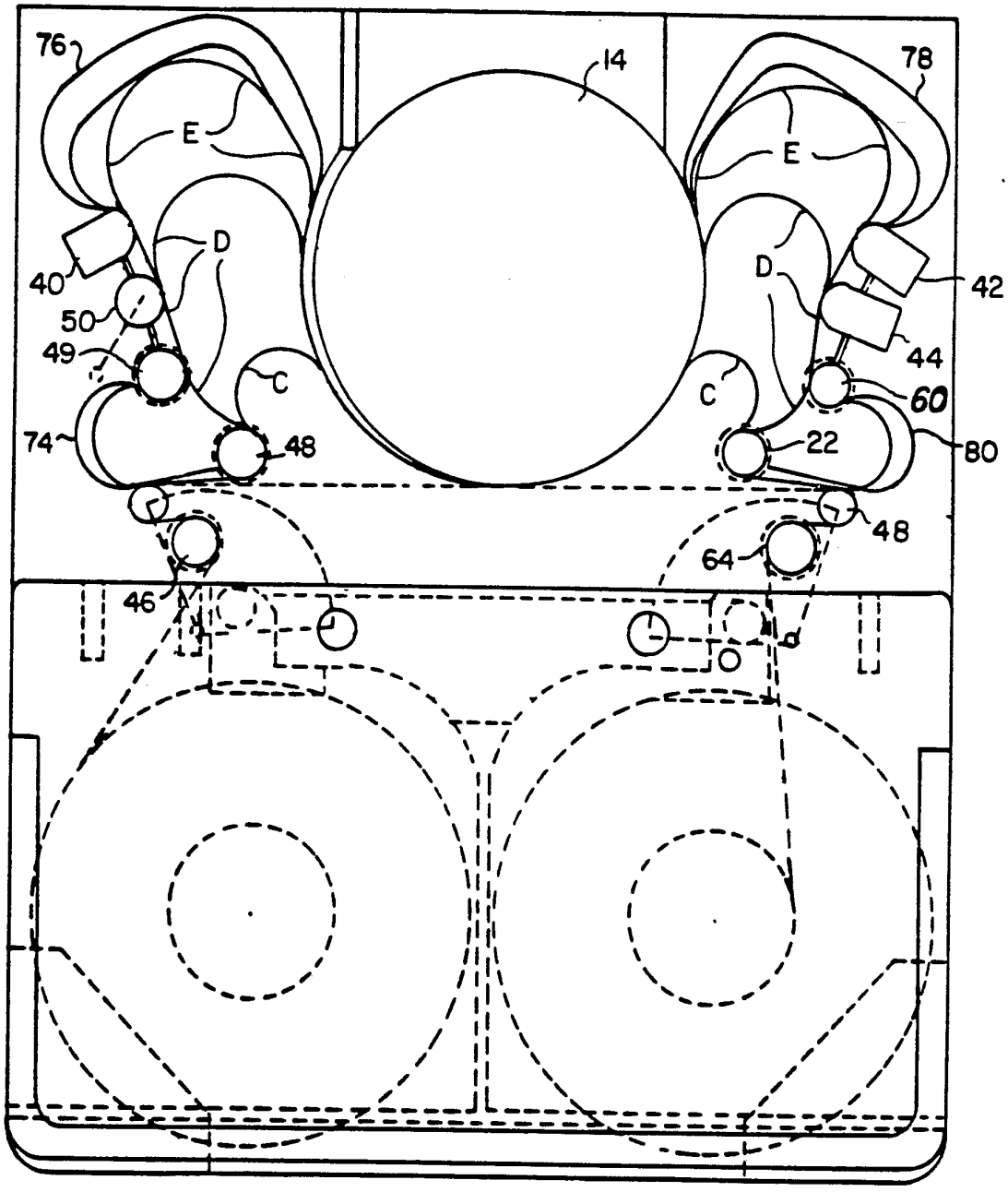


FIG. 3

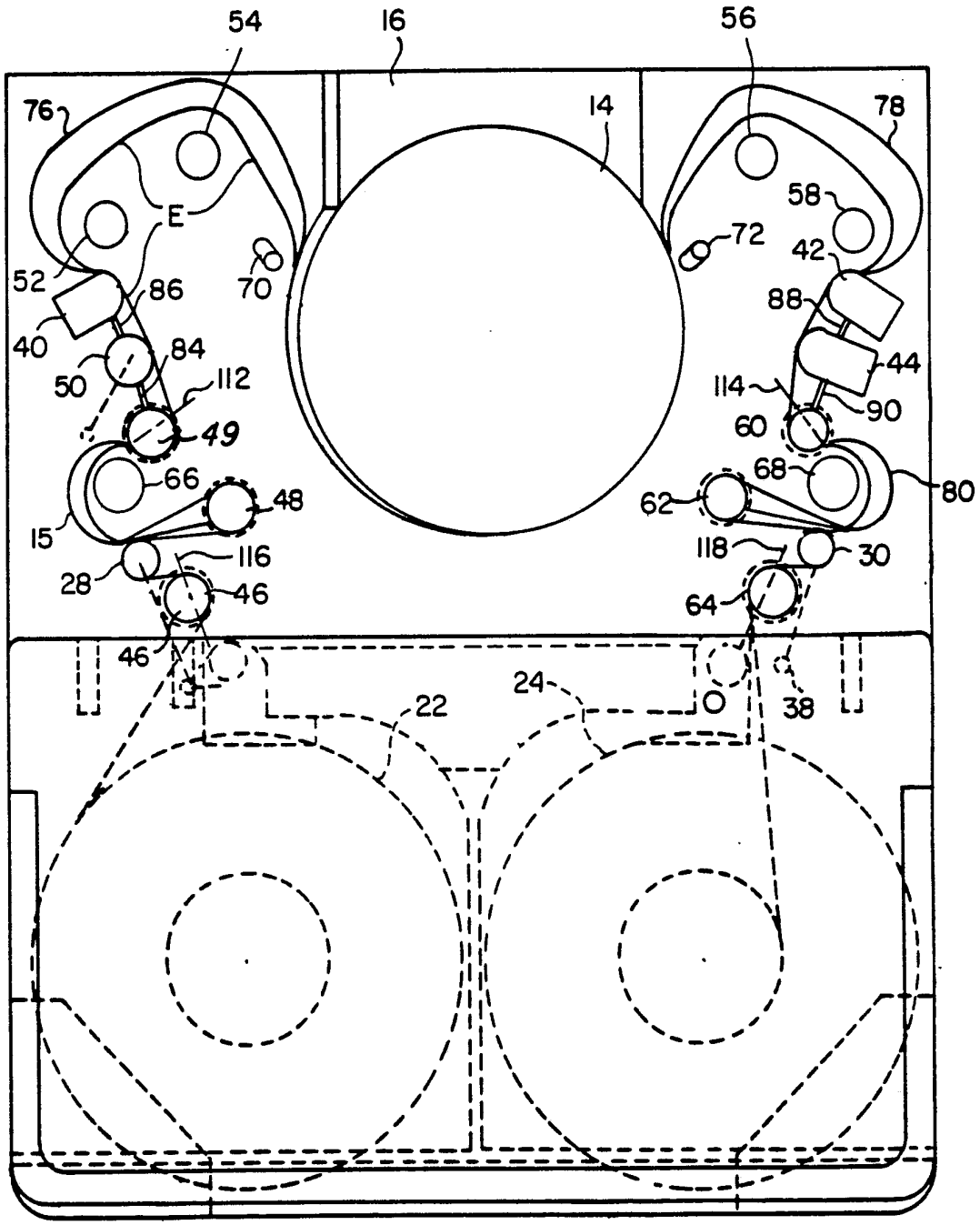

54
16
56
76
14
78
E
58
72
42
52
86
70
88
40
84
44
50
112
114
90
49
60
66
68
80
48
62
15
116
118
30
28
46
64
46
24
22
38

FIG. 4

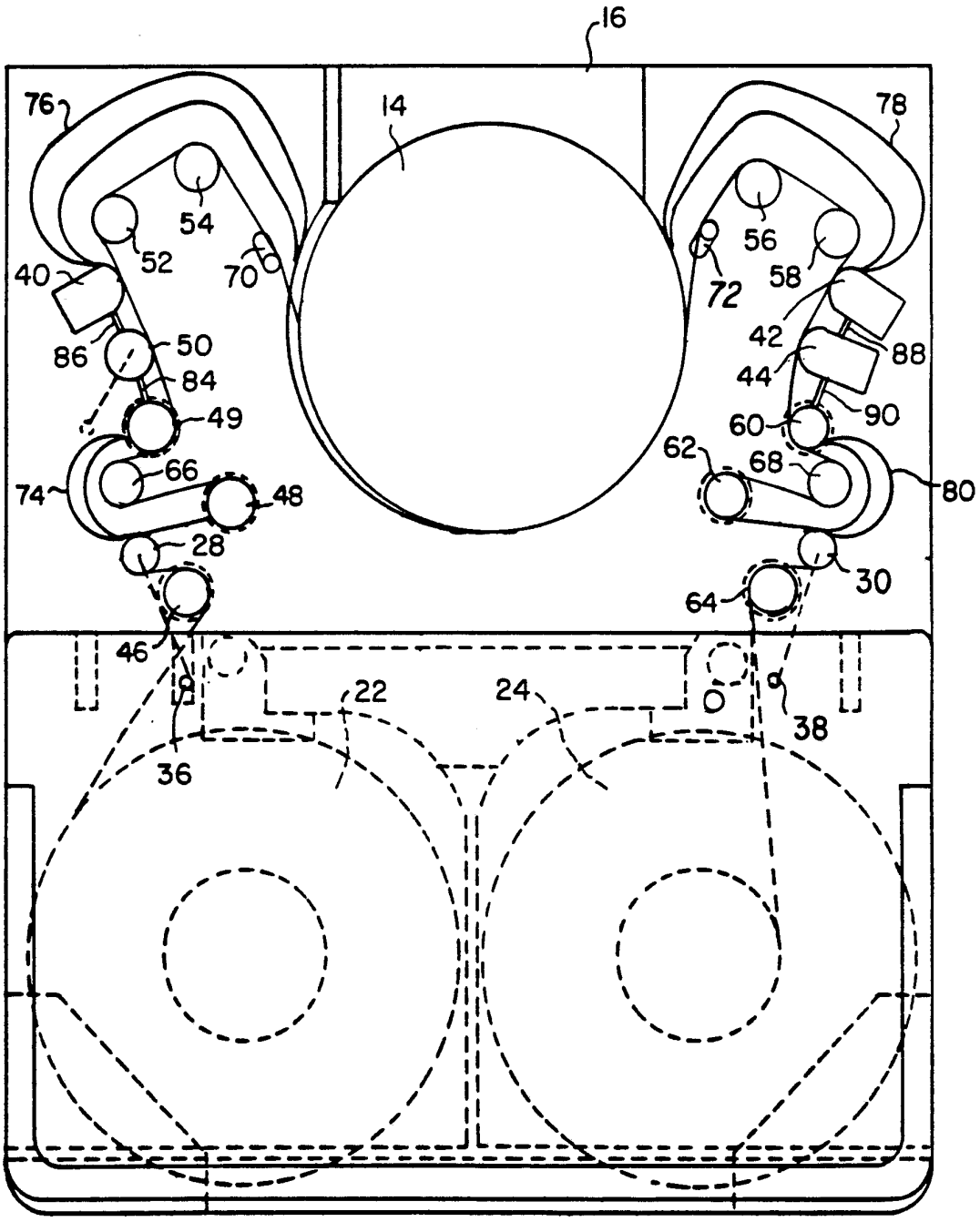

16
76
14
78
54
52
70
56
72
58
40
86
50
84
49
42
44
88
90
60
62
68
80
74
66
48
28
64
30
46
22
24
38
36

FIG. 5

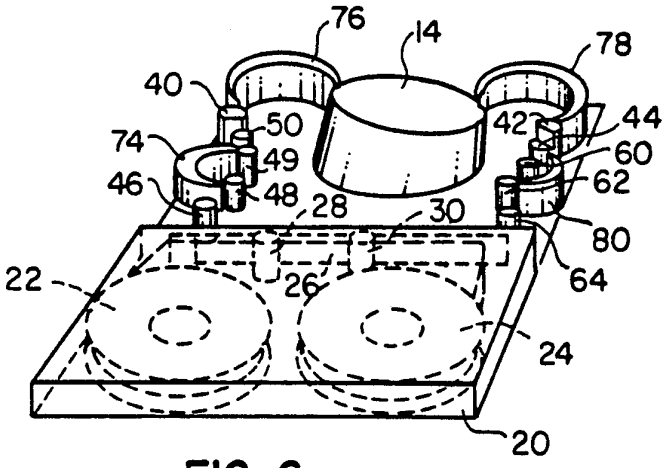


FIG. 6

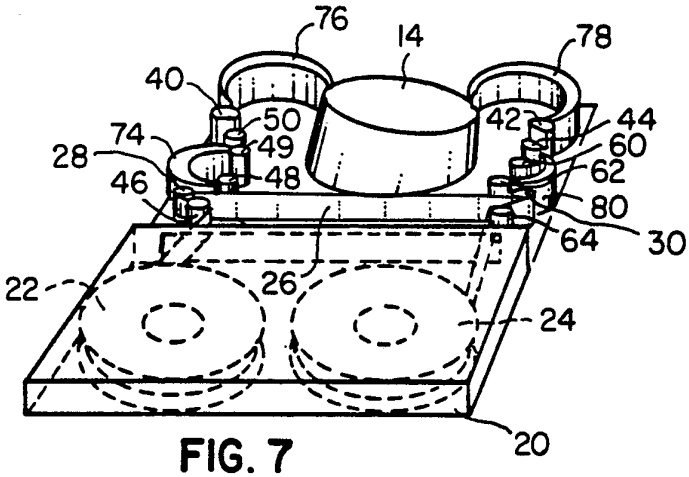


FIG. 7

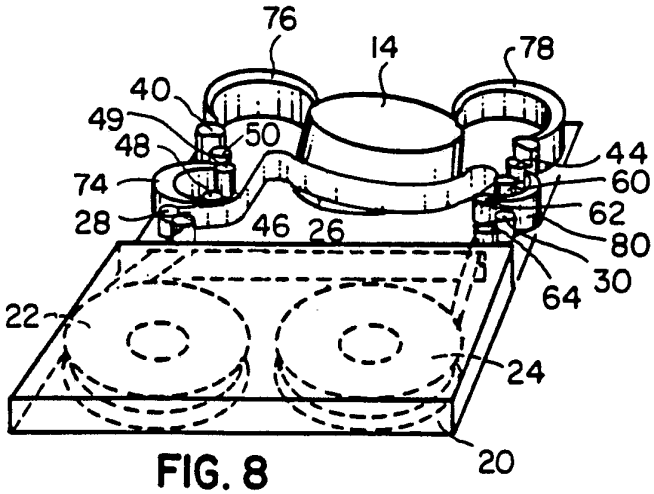


FIG. 8

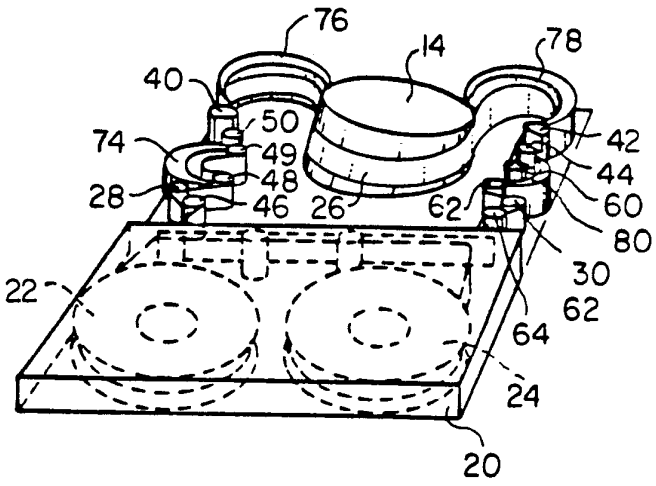

76
14
78
40
50
74
49
42
48
44
28
46
26
62
60
80
30
22
62
64
24
20

FIG. 9

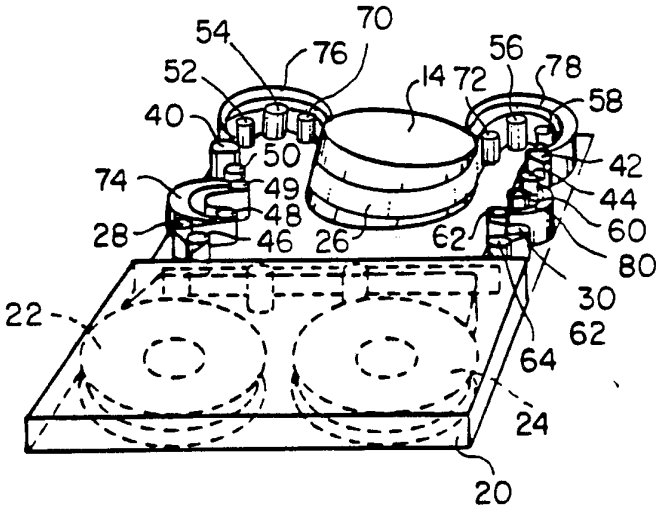

70
54
76
56
52
14
72
78
58
40
50
42
74
49
44
48
28
46
26
62
60
80
30
22
62
64
24
20

FIG. 10

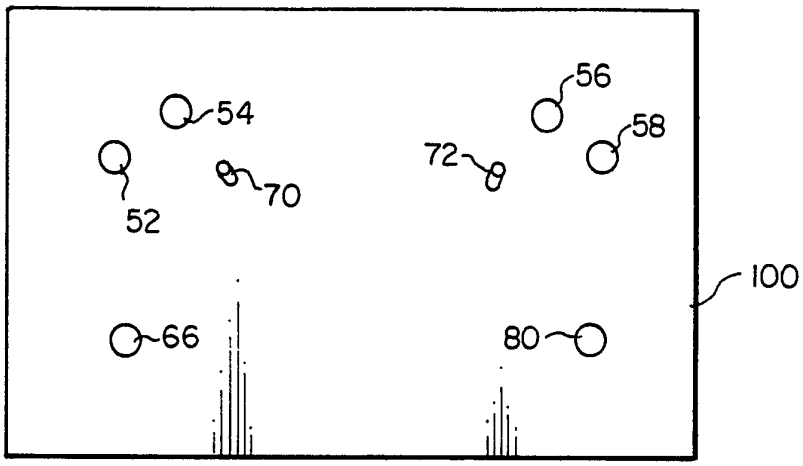

54
56
58
72
70
52
100
66
80

FIG. 11

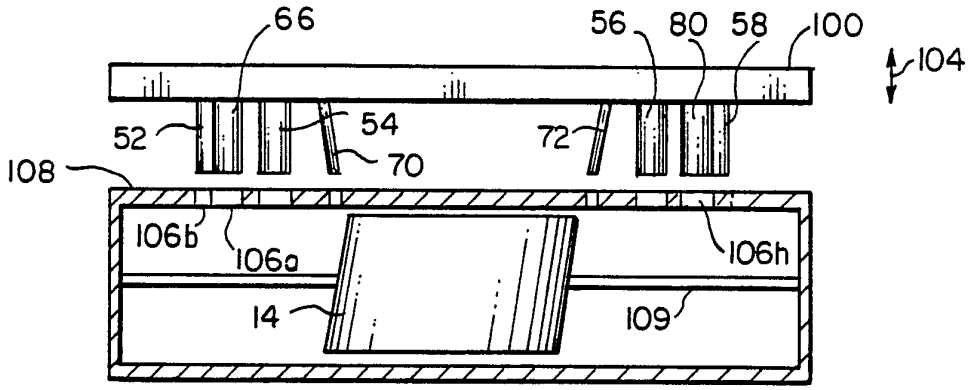

66
56
80
58
100
104
52
54
72
70
108
106b
106a
106h
14
109

FIG. 12

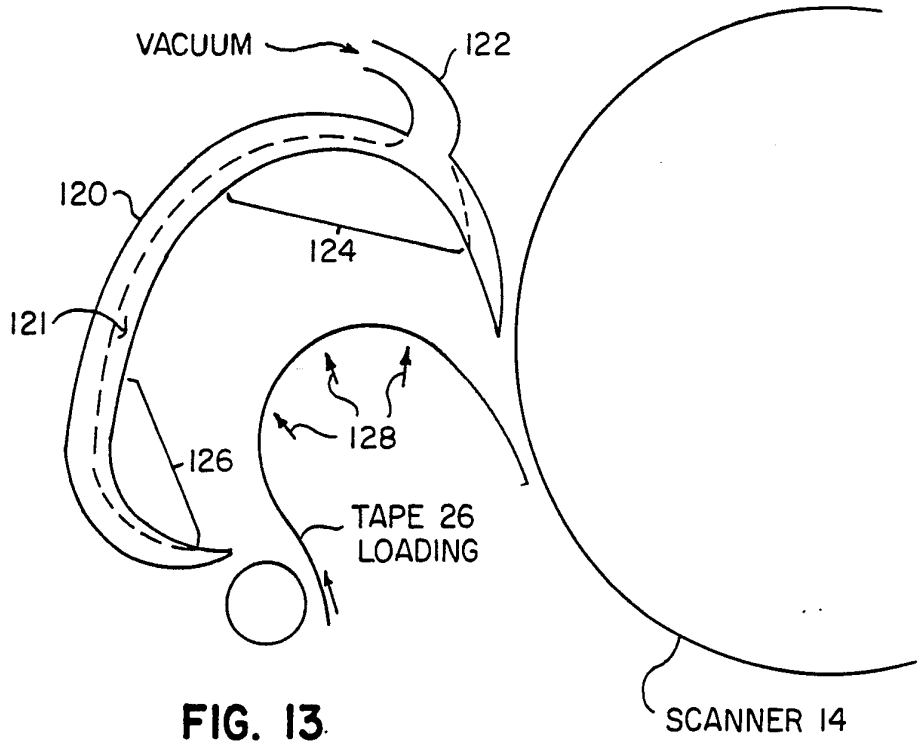

VACUUM
122
120
124
121
128
126
TAPE 26
LOADING
SCANNER 14

FIG. 13

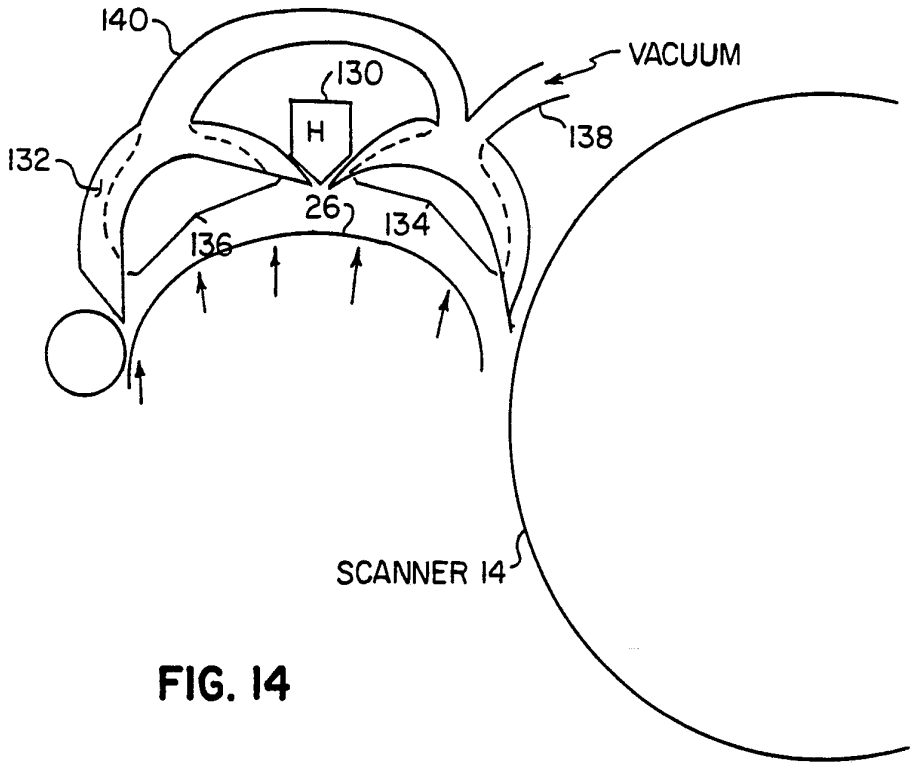

140
130
VACUUM
H
138
132
26
134
136
SCANNER 14

FIG. 14

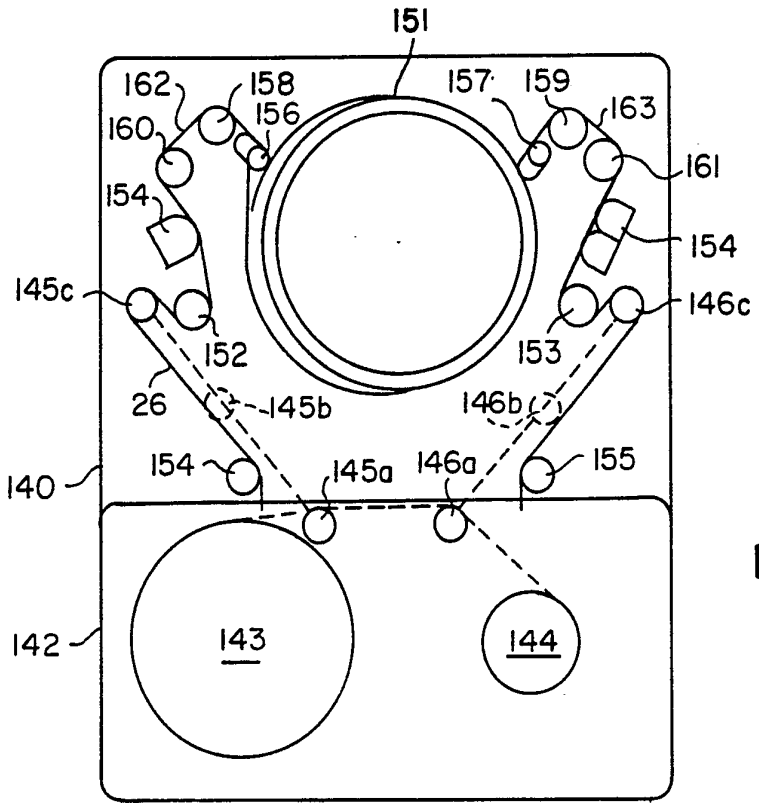

151
162
158
156
157
159
163
160
161
154
154
145c
146c
152
153
26
145b
146b
154
145a
146a
155
140
142
143
144

FIG. 15

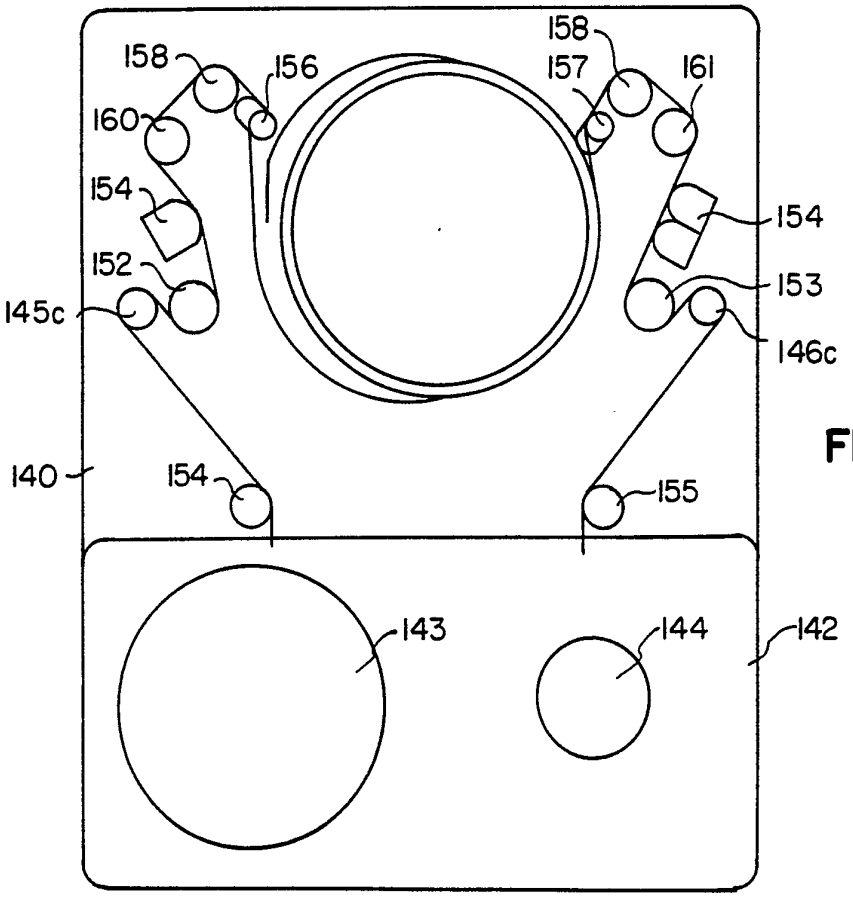

158
158
156
157
161
160
154
154
152
153
145c
146c
140
154
155
143
144
142

FIG. 16

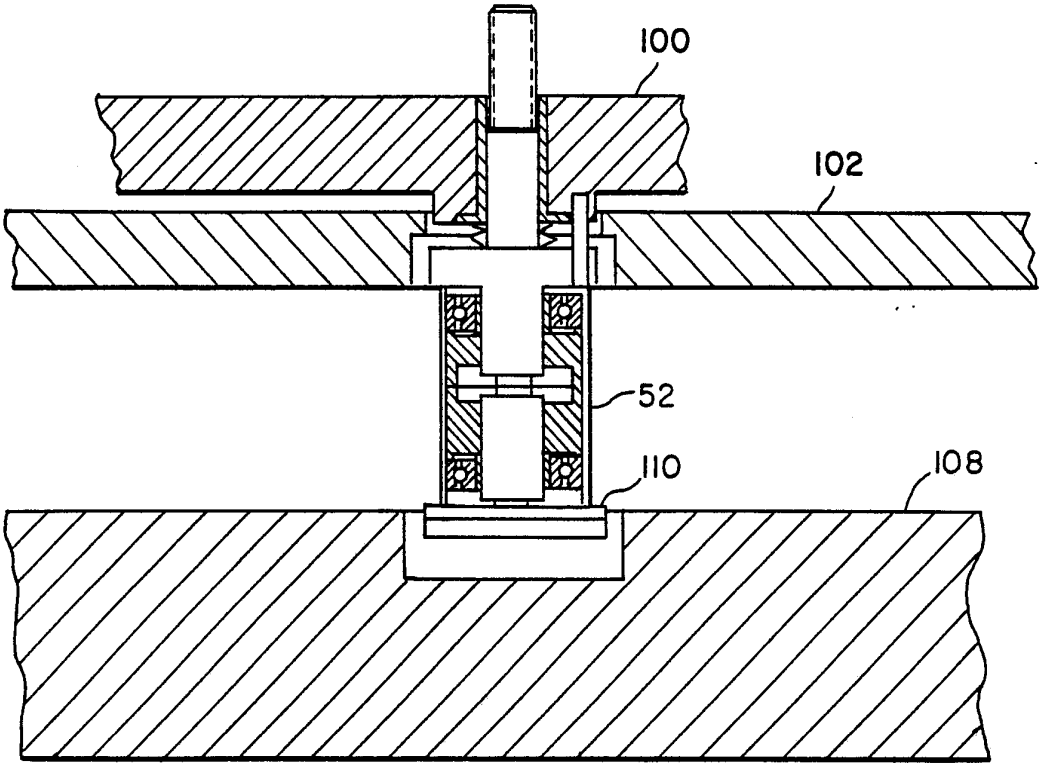


FIG. 17

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 92/04846

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

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

Int.Cl. 5 G11B15/665

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G11B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	US,A,4 991 038 (F.F.GRANT ET AL) 5 February 1991 see column 3, line 36 - column 4, line 64; figures 1-5	1,2,4
A	PATENT ABSTRACTS OF JAPAN vol. 2, no. 124 (E-064)18 October 1978 & JP,A,53 090 911 (HITACHI SEISAKUSHO) 10 August 1978 see abstract	1,2,4-6
A	PATENT ABSTRACTS OF JAPAN vol. 2, no. 137 (E-071)15 November 1978 & JP,A,53 104 210 (HITACHI SEISAKUSHO K.K.) 11 September 1978 see abstract	1,4-6

-/--

° Special categories of cited documents : [10]

"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
15 SEPTEMBER 1992	28. 09. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	DECLAT M.G.

1

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 2, no. 127 (E-066)25 October 1978 & JP,A,53 093 808 (HITACHI SEISAKUSHO K.K.) 17 August 1978 see abstract	1,4-6
A	US,A,3 940 791 (H.L.KAYAN ET AL) 24 February 1976 cited in the application see abstract; figures	1,2
A	GB,A,2 097 170 (AMPEX CORP.) 27 October 1982 see abstract; figures	1
A	& US,A,4 413 293 1 November 1983 cited in the application	
A	US,A,4 772 969 (F.F.GRANT) 20 September 1988 cited in the application see abstract; figures	1,5-7
A	DE,A,3 521 326 (GRUNDIG E.M.V.) 18 December 1986	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9204846 SA 61040

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 15/09/92

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4991038	05-02-91	None		
US-A-3940791	24-02-76	AT-B-	354758	25-01-79
		BE-A-	821464	17-02-75
		CA-A-	1054709	15-05-79
		DE-A-	2504409	11-03-76
		FR-A,B	2282694	19-03-76
		GB-A-	1483129	17-08-77
		JP-A-	51045510	19-04-76
		NL-A-	7500798	23-02-76
GB-A-2097170	27-10-82	US-A-	4413293	01-11-83
		DE-A,C	3214272	25-11-82
		DE-C-	3249755	02-03-89
		FR-A,B	2504303	22-10-82
		JP-A-	57181460	08-11-82
		NL-A-	8201601	16-11-82
US-A-4413293	01-11-83	DE-A,C	3214272	25-11-82
		DE-C-	3249755	02-03-89
		FR-A,B	2504303	22-10-82
		GB-A,B	2097170	27-10-82
		JP-A-	57181460	08-11-82
		NL-A-	8201601	16-11-82
US-A-4772969	20-09-88	EP-A-	0308486	29-03-89
		JP-T-	1501742	15-06-89
		WO-A-	8807745	06-10-88
DE-A-3521326	18-12-86	None		