		OR G02C11/06 OR G02C7/04 OR G02C7/101 OR G02C11/00 OR G02C5/143 OR G02C5/14 OR G02C7/083 OR G02C11/04 OR G02C5/001 OR G02C5/146 OR G02C2200/02 OR G02C3/003 OR G02C5/16 OR G02C5/22 OR G02C7/086 OR G02C5/02 OR G02C7/06 OR G02C2200/08 OR G02C7/16 OR G02C7/02 OR G02C5/20 OR G02C9/00 OR G02C5/12 OR G02C7/00 OR G02C7/085 OR G02C13/003 OR G02C9/04 OR G02C7/08 OR G02C7/081 OR G02C2202/10 OR G02C7/12 OR G02C2200/10 OR G02C2202/24 OR G02C7/049 OR G02C5/124 OR G02C5/2227 OR G02C5/2254 OR G02C1/00 OR G02C1/06 OR G02C1/10 OR G02C2200/06 OR G02C2200/18 OR G02C7/102 OR G02C11/08 OR G02C7/104 OR G02C2202/22 OR G02C5/2209 OR G02C5/2218 OR G02C7/088 OR G02C7/105 OR G02C3/006 OR G02C7/021 OR G02C9/02 OR G02C11/02 OR G02C5/2263 OR G02C2200/26 OR G02C5/122 OR G02C7/10).cpc.)	USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				03:07 PM

L939	4233	L17 AND ((G02B27/017 OR G02B2027/0178 OR G02B27/0172 OR G02B2027/014 OR G02B2027/0138 OR G02B2027/0187 OR G02B27/0093 OR G02B27/0176 OR G02B2027/0134 OR G02B2027/0141 OR G02B27/01 OR G02B2027/0118 OR G02B27/0179 OR G02B27/0101 OR G02B2027/0127 OR G02B2027/0174 OR G02B2027/0132 OR G02B2027/0123 OR G02B2027/0156 OR G02B2027/0185 OR G02B2027/0147 OR G02B6/34 OR G02B26/001 OR G02B13/0045 OR G02B27/0081 OR G02B26/101 OR G02B27/646 OR G02B6/005 OR G02B2027/0112 OR G02B2027/0125 OR G02B27/022 OR G02B30/34 OR G02B27/0075 OR G02B2027/0169 OR G02B7/09 OR G02B2027/0181 OR G02B13/06 OR G02B27/028 OR G02B2027/0154 OR G02B5/208 OR G02B27/4205 OR G02B5/30 OR G02B6/0035 OR G02B26/0833 OR G02B5/3025 OR G02B27/283 OR G02B6/0036 OR G02B6/0038 OR G02B6/0076 OR G02B6/10 OR G02B6/0001 OR G02B2027/012 OR G02B2027/011 OR G02B27/286 OR G02B2027/0114 OR G02B27/42 OR G02B5/32 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM

		G02B7/023 OR G02B2027/0105 OR G02B27/4227 OR G02B3/14 OR G02B9/64 OR G02B30/24 OR G02B6/0016 OR G02B6/0023 OR G02B7/08 OR G02B13/004 OR G02B27/0018 OR G02B27/30 OR G02B7/021 OR G02B5/08 OR G02B6/0068 OR G02B9/60 OR G02B7/02 OR G02B27/02 OR G02B27/00 OR G02B30/40 OR G02B7/008 OR G02B6/0053 OR G02B26/10 OR G02B26/105 OR G02B27/1086 OR G02B5/1823 OR G02B5/1857 OR G02B5/1866 OR G02B5/1871 OR G02B6/29325 OR G02B9/62 OR G02B2027/0161 OR G02B5/005 OR G02B13/02 OR G02B13/009 OR G02B7/102 OR G02B2027/0159 OR G02B30/00 OR G02B2027/015 OR G02B3/0006 OR G02B6/0055 OR G02B6/0088 OR G02B2027/0136 OR G02B21/365 OR G02B6/003 OR G02B2027/0194 OR G02B2027/0198 OR G02B6/0011 OR G02B6/0065 OR G02B7/04 OR G02B2027/0163 OR G02B21/06 OR G02B5/3083 OR G02B9/34 OR G02B13/18 OR G02B27/0977 OR G02B6/00 OR G02B2027/013 OR					

		G02B27/0149 OR G02B27/4272 OR G02B2027/0152 OR G02B5/201 OR G02B6/0051 OR G02B1/002 OR G02B5/20 OR G02B7/12 OR G02B26/0841 OR G02B27/0025 OR G02B27/0955 OR G02B1/041 OR G02B26/005 OR G02B30/56 OR G02B2027/0183 OR G02B27/0103 OR G02B13/0065 OR G02B26/00 OR G02B26/007 OR G02B26/026 OR G02B30/23 OR G02B30/52 OR G02B7/28 OR G02B2027/0116 OR G02B6/0018 OR G02B6/002 OR G02B6/0028 OR G02B6/0078 OR G02B9/04 OR G02B19/0057 OR G02B27/0916 OR G02B5/3016 OR G02B2027/0107 OR G02B2027/0129 OR G02B3/02 OR G02B5/223 OR G02B6/0056 OR G02B6/2706 OR G02B13/00 OR G02B13/001 OR G02B13/0035 OR G02B26/004 OR G02B30/27 OR G02B6/0021 OR G02B2027/0143 OR G02B26/0825 OR G02B3/00 OR G02B3/08 OR G02B6/32 OR G02B7/002 OR G02B13/0015 OR G02B13/008 OR G02B27/0037 OR G02B30/35 OR G02B6/0031 OR G02B6/0033 OR G02B1/11 OR G02B13/003 OR					

		G02B13/14 OR G02B19/009 OR G02B26/0816 OR G02B27/0006 OR G02B27/10 OR G02B27/102 OR G02B3/0037 OR G02B3/0056 OR G02B30/36 OR G02B5/04 OR G02B5/18 OR G02B6/0006 OR G02B6/0008 OR G02B6/0025 OR G02B6/009 OR G02B6/12007 OR G02B6/29316 OR G02B6/29328 OR G02B6/4204 OR G02B6/443 OR G02B6/4471 OR G02B9/36 OR G02B13/002 OR G02B13/006 OR G02B15/142 OR G02B17/0605 OR G02B2027/0145 OR G02B27/141 OR G02B27/64 OR G02B3/0068 OR G02B6/0073 OR G02B7/10 OR G02B9/12 OR G02B17/086 OR G02B27/425 OR G02B27/48 OR G02B3/12 OR G02B30/25 OR G02B5/26 OR G02B6/006 OR G02B6/0083 OR G02B6/105 OR G02B6/124 OR G02B7/003 OR G02B7/182 OR G02B27/0068 OR G02B27/0972 OR G02B27/144 OR G02B5/23 OR G02B6/001 OR G02B6/0046 OR G02B13/04 OR G02B15/10 OR G02B17/08 OR G02B2027/0196 OR G02B26/08 OR G02B27/0961 OR G02B27/1033 OR					

		G02B27/281 OR G02B3/0087 OR G02B30/10 OR G02B5/124 OR G02B6/0015 OR G02B6/0086 OR G02B6/02066 OR G02B6/29356 OR G02B6/325 OR G02B6/4206 OR G02B7/285 OR G02B13/0005 OR G02B13/0055 OR G02B2003/0093 OR G02B2027/0109 OR G02B23/00 OR G02B25/001 OR G02B27/005 OR G02B27/04 OR G02B27/149 OR G02B27/62 OR G02B30/31 OR G02B5/1809 OR G02B5/1842 OR G02B5/1847 OR G02B5/206 OR G02B6/0026 OR G02B6/0045 OR G02B6/122 OR G02B6/1221 OR G02B6/274 OR G02B6/2766 OR G02B6/42).cpc.)					
L940	1029	L17 AND ((G02C11/10 OR G02C11/06 OR G02C7/04 OR G02C11/00 OR G02C7/101 OR G02C5/14 OR G02C5/143 OR G02C5/001 OR G02C5/146 OR G02C2200/02 OR G02C3/003 OR G02C5/22 OR G02C11/04 OR G02C7/083 OR G02C5/16 OR G02C2200/08 OR G02C5/12 OR G02C7/00 OR G02C9/00 OR G02C7/081 OR G02C5/02 OR G02C7/02 OR G02C2200/10 OR G02C7/049 OR G02C7/086 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM

		G02C7/12 OR G02C7/08 OR G02C9/04 OR G02C7/16 OR G02C1/00 OR G02C1/10 OR G02C7/06 OR G02C1/06 OR G02C7/104 OR G02C5/20 OR G02C2202/10 OR G02C7/021 OR G02C7/085 OR G02C9/02 OR G02C7/105 OR G02C5/006 OR G02C5/045 OR G02C7/022 OR G02C7/041 OR G02C7/10).cpc.)					
L941	7622	L30 AND ((G02B27/017 OR G02B2027/0178 OR G02B27/0172 OR G02B2027/014 OR G02B2027/0138 OR G02B2027/0187 OR G02B27/0093 OR G02B27/0176 OR G02B2027/0141 OR G02B2027/0134 OR G02B27/01 OR G02B27/0179 OR G02B27/0101 OR G02B2027/0127 OR G02B2027/0118 OR G02B2027/0174 OR G02B2027/0132 OR G02B2027/0185 OR G02B2027/0156 OR G02B2027/0123 OR G02B26/001 OR G02B13/0045 OR G02B6/34 OR G02B27/0081 OR G02B2027/0147 OR G02B26/101 OR G02B6/005 OR G02B2027/0112 OR G02B27/646 OR G02B27/022 OR G02B30/34 OR G02B2027/0125 OR G02B2027/0169 OR G02B7/09 OR G02B13/06 OR G02B2027/0181 OR G02B27/028 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM

		G02B2027/0154 OR G02B27/0075 OR G02B5/208 OR G02B27/4205 OR G02B6/0036 OR G02B6/0038 OR G02B27/283 OR G02B6/0076 OR G02B5/3025 OR G02B6/10 OR G02B6/0001 OR G02B2027/012 OR G02B2027/0114 OR G02B27/42 OR G02B5/32 OR G02B7/023 OR G02B26/0833 OR G02B27/4227 OR G02B2027/0105 OR G02B6/0035 OR G02B9/64 OR G02B5/30 OR G02B13/004 OR G02B27/0018 OR G02B27/30 OR G02B30/24 OR G02B5/08 OR G02B6/0016 OR G02B6/0023 OR G02B6/0068 OR G02B9/60 OR G02B27/286 OR G02B7/02 OR G02B7/021 OR G02B2027/011 OR G02B27/02 OR G02B30/40 OR G02B7/008 OR G02B26/10 OR G02B26/105 OR G02B27/1086 OR G02B5/1823 OR G02B5/1857 OR G02B5/1866 OR G02B5/1871 OR G02B6/0053 OR G02B6/29325 OR G02B7/08 OR G02B9/62 OR G02B5/005 OR G02B13/02 OR G02B7/102 OR G02B2027/0161 OR G02B3/14 OR G02B2027/0159 OR G02B27/00 OR G02B30/00 OR G02B2027/015 OR					

		G02B21/365 OR G02B6/0055 OR G02B6/0088 OR G02B13/009 OR G02B2027/0198 OR G02B7/04 OR G02B2027/0136 OR G02B2027/0163 OR G02B2027/0194 OR G02B21/06 OR G02B6/0011 OR G02B6/0065 OR G02B9/34 OR G02B13/18 OR G02B2027/013 OR G02B27/0149 OR G02B27/0977 OR G02B5/3083 OR G02B5/201 OR G02B6/0051 OR G02B1/002 OR G02B3/0006 OR G02B5/20 OR G02B26/0841 OR G02B27/0955 OR G02B7/12 OR G02B1/041 OR G02B2027/0152 OR G02B27/0025 OR G02B2027/0183 OR G02B26/005 OR G02B27/0103 OR G02B27/4272 OR G02B6/00 OR G02B13/0065 OR G02B26/00 OR G02B26/007 OR G02B26/026 OR G02B30/23 OR G02B30/52 OR G02B2027/0116 OR G02B30/56 OR G02B6/0078 OR G02B9/04 OR G02B19/0057 OR G02B27/0916 OR G02B6/0028 OR G02B6/003 OR G02B2027/0107 OR G02B6/0018 OR G02B6/002 OR G02B2027/0129 OR G02B3/02 OR G02B5/3016 OR G02B6/0056 OR G02B13/0035 OR G02B6/0021 OR G02B6/2706 OR					

		G02B13/00 OR G02B26/004 OR G02B3/08 OR G02B13/0015 OR G02B13/008 OR G02B2027/0143 OR G02B27/0037 OR G02B6/0031 OR G02B6/0033 OR G02B7/002 OR G02B7/28 OR G02B13/003 OR G02B13/14 OR G02B19/009 OR G02B27/0006 OR G02B27/102 OR G02B3/00 OR G02B3/0037 OR G02B3/0056 OR G02B30/36 OR G02B5/04 OR G02B5/223 OR G02B6/0025 OR G02B6/009 OR G02B6/12007 OR G02B6/29316 OR G02B6/29328 OR G02B9/36 OR G02B1/11 OR G02B13/002 OR G02B15/142 OR G02B2027/0145 OR G02B27/141 OR G02B3/0068 OR G02B6/0073 OR G02B9/12 OR G02B13/001 OR G02B13/006 OR G02B17/086 OR G02B27/425 OR G02B27/48 OR G02B27/64 OR G02B3/12 OR G02B30/25 OR G02B30/35 OR G02B5/18 OR G02B6/0083 OR G02B6/124 OR G02B6/32 OR G02B7/10 OR G02B7/182 OR G02B26/0816 OR G02B27/0068 OR G02B27/0972 OR G02B27/10 OR G02B5/26 OR G02B6/001 OR G02B6/006 OR					

		G02B7/003 OR G02B13/04 OR G02B15/10 OR G02B17/08 OR G02B26/08 OR G02B27/0961 OR G02B27/281 OR G02B3/0087 OR G02B5/124 OR G02B6/0015 OR G02B6/0046 OR G02B6/0086 OR G02B6/29356 OR G02B6/4206 OR G02B13/0055 OR G02B17/0605 OR G02B2003/0093 OR G02B2027/0109 OR G02B23/00 OR G02B25/001 OR G02B27/005 OR G02B27/62 OR G02B30/27 OR G02B30/31 OR G02B5/1809 OR G02B5/1842 OR G02B5/1847 OR G02B5/206 OR G02B5/23 OR G02B6/0026 OR G02B6/0045 OR G02B6/122 OR G02B6/1221 OR G02B6/42 OR G02B7/285).cpc.)					
L942	1814	L30 AND ((G02C11/10 OR G02C11/06 OR G02C7/04 OR G02C11/00 OR G02C5/14 OR G02C7/101 OR G02C5/143 OR G02C5/001 OR G02C3/003 OR G02C5/146 OR G02C2200/02 OR G02C5/22 OR G02C11/04 OR G02C5/16 OR G02C7/083 OR G02C2200/08 OR G02C5/12 OR G02C9/00 OR G02C5/02 OR G02C2200/10 OR G02C7/081 OR G02C7/086 OR G02C7/00 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM

		G02C7/02 OR G02C9/04 OR G02C7/16 OR G02C7/049 OR G02C1/00 OR G02C1/10 OR G02C7/06 OR G02C7/08 OR G02C1/06 OR G02C5/20 OR G02C7/021 OR G02C7/12 OR G02C2202/10 OR G02C7/085 OR G02C5/006 OR G02C9/02 OR G02C5/045 OR G02C7/10 OR G02C7/104).cpc.)					
L943	2058	L43 AND ((G02B27/017 OR G02B2027/0178 OR G02B27/0172 OR G02B2027/014 OR G02B2027/0138 OR G02B27/0093 OR G02B2027/0187 OR G02B27/0176 OR G02B2027/0127 OR G02B27/0101 OR G02B2027/0118 OR G02B2027/0134 OR G02B2027/0141 OR G02B27/0179 OR G02B2027/0156 OR G02B2027/0174 OR G02B2027/0132 OR G02B6/34 OR G02B2027/0123 OR G02B2027/0185 OR G02B27/01 OR G02B2027/0147 OR G02B27/4205 OR G02B26/101 OR G02B27/4227 OR G02B6/10 OR G02B2027/0105 OR G02B27/42 OR G02B26/001 OR G02B27/0081 OR G02B2027/0112 OR G02B13/0045 OR G02B2027/0169 OR G02B6/0001 OR G02B27/0075 OR G02B2027/0125 OR G02B27/028 OR G02B27/646 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02B6/0035 OR G02B27/022 OR G02B5/30 OR G02B6/005 OR G02B2027/0181 OR G02B2027/012 OR G02B26/0833 OR G02B27/283 OR G02B6/0038 OR G02B13/06 OR G02B6/0036 OR G02B2027/011 OR G02B3/14 OR G02B5/3025 OR G02B2027/0161 OR G02B7/09 OR G02B2027/0114 OR G02B27/286 OR G02B27/30 OR G02B5/32 OR G02B6/0016 OR G02B2027/0154 OR G02B27/0018 OR G02B6/0023 OR G02B6/0076 OR G02B5/3083 OR G02B6/003 OR G02B26/105 OR G02B5/208 OR G02B7/008 OR G02B2027/0194 OR G02B6/0068 OR G02B9/60 OR G02B9/64 OR G02B27/1086 OR G02B30/34 OR G02B5/005 OR G02B5/1823 OR G02B5/1857 OR G02B5/1866 OR G02B5/1871 OR G02B6/0055 OR G02B6/29325 OR G02B7/08 OR G02B13/004 OR G02B13/009 OR G02B2027/015 OR G02B27/0977 OR G02B5/08 OR G02B19/0057 OR G02B27/0916 OR G02B6/00 OR G02B6/0053 OR G02B7/102 OR G02B13/02 OR G02B2027/013 OR G02B2027/0136 OR G02B26/10 OR					

		G02B27/0103 OR G02B27/0149 OR G02B30/56 OR G02B27/0025 OR G02B27/4272 OR G02B30/27 OR G02B30/52 OR G02B6/0088 OR G02B9/62 OR G02B13/0065 OR G02B30/00 OR G02B6/0006 OR G02B6/0008 OR G02B6/4204 OR G02B6/443 OR G02B6/4471 OR G02B7/023 OR G02B2027/0145 OR G02B2027/0159 OR G02B2027/0163 OR G02B3/0006 OR G02B6/0065 OR G02B7/02 OR G02B7/04 OR G02B7/12 OR G02B1/002 OR G02B17/086 OR G02B2027/0152 OR G02B21/365 OR G02B26/0816 OR G02B27/02 OR G02B30/35 OR G02B5/04 OR G02B5/3016 OR G02B6/0018 OR G02B6/0031 OR G02B6/0078 OR G02B6/105 OR G02B7/003 OR G02B7/021 OR G02B9/34 OR G02B1/041 OR G02B15/10 OR G02B26/005 OR G02B27/00 OR G02B27/0955 OR G02B27/10 OR G02B27/1033 OR G02B6/002 OR G02B6/0051 OR G02B6/124 OR G02B13/001 OR G02B13/0035 OR G02B2027/0109 OR G02B2027/0183 OR G02B21/06 OR G02B26/00 OR G02B26/0841 OR					

		G02B27/141 OR G02B27/425 OR G02B3/0087 OR G02B5/1809 OR G02B5/1847 OR G02B6/0026 OR G02B6/02066 OR G02B6/122 OR G02B6/1221 OR G02B6/274 OR G02B6/2766 OR G02B9/04 OR G02B13/008 OR G02B13/14 OR G02B2027/0107 OR G02B2027/0143 OR G02B26/004 OR G02B26/007 OR G02B27/0037 OR G02B5/18 OR G02B5/20 OR G02B5/201 OR G02B6/0021 OR G02B6/0056 OR G02B6/32 OR G02B7/002 OR G02B9/36 OR G02B13/00 OR G02B13/0015 OR G02B13/003 OR G02B13/04 OR G02B13/18 OR G02B15/142 OR G02B19/009 OR G02B2027/0116 OR G02B27/0972 OR G02B27/281 OR G02B27/64 OR G02B3/00 OR G02B30/10 OR G02B30/24 OR G02B30/26 OR G02B5/26 OR G02B6/0028 OR G02B6/0045 OR G02B6/0046 OR G02B6/0073 OR G02B6/0083 OR G02B6/009 OR G02B9/12 OR G02B13/006 OR G02B17/0605 OR G02B2003/0093 OR G02B2027/0198 OR G02B2207/113 OR G02B25/001 OR G02B26/103 OR G02B27/0944 OR					

		G02B27/1046 OR G02B27/4294 OR G02B27/58 OR G02B3/0056 OR G02B3/08 OR G02B3/12 OR G02B5/124 OR G02B5/223 OR G02B5/3058 OR G02B6/0025 OR G02B6/0033 OR G02B6/0061 OR G02B6/12009 OR G02B6/29356 OR G02B7/10 OR G02B1/00 OR G02B1/10 OR G02B1/11 OR G02B13/002 OR G02B13/007 OR G02B15/1421 OR G02B15/143503 OR G02B15/144105 OR G02B15/144113 OR G02B15/1451 OR G02B15/26 OR G02B19/0014 OR G02B19/0076 OR G02B2027/0129 OR G02B2027/019 OR G02B2027/0196 OR G02B21/0012 OR G02B2207/115 OR G02B23/00 OR G02B23/18 OR G02B26/023 OR G02B26/0808 OR G02B26/085 OR G02B26/0858 OR G02B26/0875 OR G02B27/0189 OR G02B27/024 OR G02B27/144 OR G02B27/149 OR G02B27/28 OR G02B27/288 OR G02B27/44 OR G02B27/48 OR G02B3/005 OR G02B30/22 OR G02B30/36 OR G02B30/50 OR G02B5/0284 OR G02B5/1842 OR G02B5/1876 OR G02B5/22 OR G02B5/23 OR G02B6/0011 OR				

		G02B6/0015 OR G02B6/0048 OR G02B6/0058 OR G02B6/006 OR G02B6/0086 OR G02B6/02 OR G02B6/06 OR G02B6/12019 OR G02B6/27 OR G02B6/4206 OR G02B7/005 OR G02B7/028 OR G02B7/105 OR G02B7/1821 OR G02B7/1822 OR G02B7/1824 OR G02B7/28 OR G02B7/285 OR G02B7/346 OR G02B7/38 OR G02B9/18).cpc.)					
L944	516	L43 AND ((G02C11/10 OR G02C11/06 OR G02C7/04 OR G02C5/143 OR G02C11/00 OR G02C5/146 OR G02C5/001 OR G02C5/14 OR G02C7/101 OR G02C3/003 OR G02C2200/08 OR G02C2200/02 OR G02C7/083 OR G02C7/12 OR G02C5/16 OR G02C5/22 OR G02C7/16 OR G02C7/086 OR G02C9/04 OR G02C11/04 OR G02C2200/10 OR G02C5/12 OR G02C9/00 OR G02C7/06 OR G02C7/081 OR G02C7/104 OR G02C5/02 OR G02C7/105 OR G02C7/08 OR G02C5/006 OR G02C7/00 OR G02C1/10 OR G02C5/20 OR G02C5/045 OR G02C7/021 OR G02C1/06 OR G02C2202/06 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02C3/006 OR G02C5/08 OR G02C5/2209 OR G02C5/2272 OR G02C9/02 OR G02C2200/26 OR G02C3/04 OR G02C5/2236 OR G02C5/2254 OR G02C5/2263 OR G02C7/02).cpc.)					
L945	1745	L44 AND ((G02B27/017 OR G02B2027/0178 OR G02B27/0172 OR G02B2027/014 OR G02B2027/0138 OR G02B27/0093 OR G02B2027/0187 OR G02B27/0176 OR G02B2027/0127 OR G02B2027/0118 OR G02B2027/0134 OR G02B27/0101 OR G02B27/0179 OR G02B2027/0141 OR G02B2027/0156 OR G02B6/34 OR G02B2027/0132 OR G02B2027/0174 OR G02B2027/0185 OR G02B2027/0123 OR G02B2027/0147 OR G02B27/01 OR G02B27/4205 OR G02B6/10 OR G02B2027/0105 OR G02B26/101 OR G02B27/42 OR G02B27/4227 OR G02B26/001 OR G02B2027/0169 OR G02B27/0081 OR G02B27/0075 OR G02B27/028 OR G02B2027/0112 OR G02B2027/0125 OR G02B6/0001 OR G02B6/0035 OR G02B27/022 OR G02B6/005 OR G02B2027/012 OR G02B27/283 OR G02B5/30 OR G02B6/0038 OR G02B6/0036 OR G02B13/0045 OR G02B2027/0181 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02B5/3025 OR G02B2027/0161 OR G02B2027/011 OR G02B2027/0114 OR G02B27/30 OR G02B6/0016 OR G02B2027/0154 OR G02B27/286 OR G02B3/14 OR G02B6/0023 OR G02B5/3083 OR G02B6/003 OR G02B6/0076 OR G02B27/0018 OR G02B7/008 OR G02B26/0833 OR G02B13/06 OR G02B2027/0194 OR G02B27/1086 OR G02B5/1823 OR G02B5/1857 OR G02B5/1866 OR G02B5/1871 OR G02B6/0055 OR G02B6/29325 OR G02B2027/015 OR G02B30/34 OR G02B26/105 OR G02B6/0053 OR G02B26/10 OR G02B27/0103 OR G02B27/646 OR G02B5/08 OR G02B9/60 OR G02B2027/0136 OR G02B30/27 OR G02B30/52 OR G02B5/208 OR G02B6/0068 OR G02B6/0088 OR G02B7/09 OR G02B9/62 OR G02B13/009 OR G02B2027/013 OR G02B30/56 OR G02B5/32 OR G02B6/0006 OR G02B6/0008 OR G02B6/4204 OR G02B6/443 OR G02B6/4471 OR G02B9/64 OR G02B2027/0163 OR G02B27/0977 OR G02B6/0065 OR G02B13/004 OR G02B2027/0159 OR G02B30/00 OR					

		G02B6/00 OR G02B7/023 OR G02B7/12 OR G02B1/002 OR G02B17/086 OR G02B2027/0145 OR G02B21/365 OR G02B27/0025 OR G02B27/02 OR G02B5/04 OR G02B5/3016 OR G02B6/0018 OR G02B6/0031 OR G02B6/105 OR G02B7/003 OR G02B13/02 OR G02B2027/0152 OR G02B27/00 OR G02B27/0149 OR G02B27/10 OR G02B27/1033 OR G02B27/4272 OR G02B6/002 OR G02B6/0051 OR G02B6/124 OR G02B13/001 OR G02B13/0035 OR G02B15/10 OR G02B2027/0109 OR G02B2027/0183 OR G02B21/06 OR G02B26/00 OR G02B27/141 OR G02B27/425 OR G02B3/0006 OR G02B30/35 OR G02B5/005 OR G02B5/1809 OR G02B5/1847 OR G02B6/0026 OR G02B6/02066 OR G02B6/122 OR G02B6/1221 OR G02B6/274 OR G02B6/2766 OR G02B7/021 OR G02B7/04 OR G02B7/08 OR G02B1/041 OR G02B13/0065 OR G02B13/008 OR G02B13/14 OR G02B2027/0107 OR G02B2027/0143 OR G02B26/005 OR G02B26/007 OR G02B5/20 OR G02B6/0056 OR					

		G02B6/32 OR G02B7/002 OR G02B9/36 OR G02B13/003 OR G02B13/18 OR G02B15/142 OR G02B19/009 OR G02B2027/0116 OR G02B26/0816 OR G02B27/0972 OR G02B27/281 OR G02B27/64 OR G02B3/00 OR G02B30/10 OR G02B30/24 OR G02B30/26 OR G02B5/18 OR G02B5/26 OR G02B6/0045 OR G02B6/0046 OR G02B6/0073 OR G02B6/0083 OR G02B6/009 OR G02B7/02 OR G02B7/102 OR G02B9/04 OR G02B9/12 OR G02B9/34 OR G02B17/0605 OR G02B2027/0198 OR G02B2207/113 OR G02B25/001 OR G02B26/0841 OR G02B26/103 OR G02B27/0037 OR G02B27/0944 OR G02B27/0955 OR G02B27/1046 OR G02B27/4294 OR G02B27/58 OR G02B5/124 OR G02B5/201 OR G02B5/223 OR G02B6/0025 OR G02B6/0028 OR G02B6/0033 OR G02B6/0061 OR G02B6/0078 OR G02B6/12009 OR G02B6/29356 OR G02B1/00 OR G02B1/10 OR G02B13/007 OR G02B13/04 OR G02B15/1421 OR G02B2027/0129 OR G02B2027/019 OR G02B2027/0196 OR					

		G02B21/0012 OR G02B2207/115 OR G02B23/00 OR G02B23/18 OR G02B26/004 OR G02B26/0808 OR G02B26/085 OR G02B26/0858 OR G02B26/0875 OR G02B27/0189 OR G02B27/024 OR G02B27/144 OR G02B27/149 OR G02B27/44 OR G02B27/48 OR G02B3/005 OR G02B30/22 OR G02B30/36 OR G02B30/50 OR G02B5/0284 OR G02B5/1842 OR G02B5/1876 OR G02B5/22 OR G02B5/23 OR G02B5/3058 OR G02B6/0011 OR G02B6/0015 OR G02B6/0048 OR G02B6/0058 OR G02B6/006 OR G02B6/0086 OR G02B6/02 OR G02B6/06 OR G02B6/12019 OR G02B6/27 OR G02B7/005 OR G02B7/105 OR G02B7/1824 OR G02B7/28 OR G02B7/285 OR G02B7/346 OR G02B1/007 OR G02B1/04 OR G02B1/115 OR G02B1/118 OR G02B13/0055 OR G02B13/006 OR G02B13/0075 OR G02B15/06 OR G02B17/08 OR G02B19/0047 OR G02B2003/0093 OR G02B2027/0158 OR G02B2027/0192 OR G02B21/00 OR G02B2207/101 OR G02B2207/123 OR G02B27/0068 OR					

		G02B27/0938 OR G02B27/0961 OR G02B27/108 OR G02B27/142 OR G02B27/28 OR G02B27/285 OR G02B27/62 OR G02B3/0037 OR G02B3/0056 OR G02B3/0068 OR G02B3/02 OR G02B3/04 OR G02B3/08 OR G02B30/29 OR G02B30/31 OR G02B5/0252 OR G02B5/045 OR G02B5/0841 OR G02B5/10 OR G02B5/12 OR G02B5/122 OR G02B5/128 OR G02B5/136 OR G02B5/1861 OR G02B5/28 OR G02B6/0085 OR G02B6/2706 OR G02B6/276 OR G02B6/29311 OR G02B6/3512 OR G02B6/3522 OR G02B6/4214 OR G02B7/10 OR G02B7/287).cpc.)					
L946	479	L44 AND ((G02C11/10 OR G02C11/06 OR G02C7/04 OR G02C5/143 OR G02C5/146 OR G02C11/00 OR G02C5/14 OR G02C7/101 OR G02C5/001 OR G02C3/003 OR G02C2200/08 OR G02C7/083 OR G02C2200/02 OR G02C7/12 OR G02C5/16 OR G02C7/16 OR G02C7/086 OR G02C9/04 OR G02C2200/10 OR G02C5/22 OR G02C11/04 OR G02C9/00 OR G02C7/06 OR G02C7/081 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02C5/02 OR G02C5/12 OR G02C7/104 OR G02C7/105 OR G02C7/08 OR G02C5/006 OR G02C7/00 OR G02C5/20 OR G02C5/045 OR G02C7/021 OR G02C2202/06 OR G02C3/006 OR G02C5/08 OR G02C5/2209 OR G02C5/2272 OR G02C9/02 OR G02C1/10 OR G02C2200/26 OR G02C3/04 OR G02C5/2236 OR G02C5/2254 OR G02C5/2263 OR G02C7/02 OR G02C11/08 OR G02C13/005 OR G02C2202/10 OR G02C5/003 OR G02C5/126 OR G02C5/2227 OR G02C5/2281 OR G02C7/022 OR G02C7/085).cpc.)					
L947	618	L45 AND ((G02B27/017 OR G02B2027/0178 OR G02B2027/014 OR G02B27/0172 OR G02B2027/0138 OR G02B27/0093 OR G02B2027/0187 OR G02B2027/0118 OR G02B27/0176 OR G02B27/0101 OR G02B2027/0134 OR G02B2027/0127 OR G02B6/34 OR G02B2027/0123 OR G02B2027/0147 OR G02B5/30 OR G02B27/0081 OR G02B27/0179 OR G02B2027/0185 OR G02B27/4205 OR G02B6/005 OR G02B2027/0105 OR G02B27/01 OR G02B27/42 OR G02B27/4227 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02B6/10 OR G02B2027/0174 OR G02B6/0038 OR G02B6/0076 OR G02B7/008 OR G02B27/283 OR G02B2027/0114 OR G02B2027/012 OR G02B2027/0125 OR G02B2027/0132 OR G02B27/0018 OR G02B27/1086 OR G02B27/30 OR G02B5/1823 OR G02B5/1857 OR G02B5/1866 OR G02B5/1871 OR G02B5/3025 OR G02B6/0016 OR G02B6/0023 OR G02B6/0035 OR G02B6/0036 OR G02B6/29325 OR G02B2027/0156 OR G02B2027/0141 OR G02B27/0103 OR G02B26/001 OR G02B7/12 OR G02B30/52 OR G02B1/002 OR G02B2027/0161 OR G02B21/06 OR G02B21/365 OR G02B26/00 OR G02B27/02 OR G02B27/10 OR G02B27/286 OR G02B30/34 OR G02B30/56 OR G02B5/08 OR G02B5/1809 OR G02B5/1847 OR G02B5/3083 OR G02B6/0026 OR G02B6/122 OR G02B6/1221 OR G02B6/124 OR G02B7/04 OR G02B2027/0109 OR G02B2027/0136 OR G02B26/101 OR G02B6/0018 OR G02B6/002 OR G02B19/009 OR G02B2027/0116 OR G02B2027/013 OR G02B2027/015 OR G02B2027/0152 OR					

		G02B2027/0163 OR G02B2027/0181 OR G02B26/105 OR G02B27/0075 OR G02B27/0149 OR G02B6/0053 OR G02B2027/011 OR G02B2027/0112 OR G02B2027/0154 OR G02B2027/0194 OR G02B27/00 OR G02B27/141 OR G02B5/04 OR G02B5/18 OR G02B6/00 OR G02B6/12009 OR G02B2027/0159 OR G02B2207/113 OR G02B2207/115 OR G02B26/0816 OR G02B26/103 OR G02B3/005 OR G02B30/35 OR G02B30/36 OR G02B5/23 OR G02B5/3058 OR G02B6/0028 OR G02B6/003 OR G02B6/0045 OR G02B6/0055 OR G02B6/0056 OR G02B6/006 OR G02B6/0065 OR G02B6/0068 OR G02B6/0088 OR G02B6/12019 OR G02B1/041 OR G02B19/0047 OR G02B2003/0093 OR G02B2027/019 OR G02B2027/0192 OR G02B21/0012 OR G02B27/0025 OR G02B27/0189 OR G02B27/0961 OR G02B27/0972 OR G02B3/00 OR G02B3/0068 OR G02B3/08 OR G02B3/14 OR G02B30/26 OR G02B5/045 OR G02B5/1842 OR G02B5/28 OR G02B6/32 OR G02B6/3512 OR G02B7/287).cpc.)					
L948	327	L45 AND ((G02C11/10	(US-PGPUB; USPAT;	OR	ON	ON	2022/12/05

		OR G02C11/06 OR G02C5/143 OR G02C5/14 OR G02C7/101 OR G02C3/003 OR G02C7/04 OR G02C5/001 OR G02C5/146 OR G02C7/083 OR G02C2200/08 OR G02C11/00 OR G02C5/16 OR G02C2200/10 OR G02C11/04 OR G02C7/12 OR G02C7/081 OR G02C7/06 OR G02C7/104 OR G02C7/16 OR G02C7/08 OR G02C2200/02 OR G02C7/00 OR G02C7/105 OR G02C9/00 OR G02C7/086 OR G02C9/04 OR G02C5/20 OR G02C7/021 OR G02C2202/06 OR G02C5/006 OR G02C5/045 OR G02C5/08 OR G02C5/2209 OR G02C5/2272 OR G02C1/10 OR G02C5/12 OR G02C5/22 OR G02C5/2236 OR G02C5/2254 OR G02C7/02 OR G02C11/08 OR G02C13/005 OR G02C5/02 OR G02C5/2227 OR G02C5/2263 OR G02C5/2281 OR G02C7/022 OR G02C9/02).cpc.)	USOCR; EPO; JPO; DERWENT)				03:07 PM
L949	135	L47 AND ((G02B2027/0178 OR G02B27/017 OR G02B2027/014 OR G02B27/0172 OR G02B27/0093 OR G02B2027/0138 OR G02B2027/0187 OR G02B6/34 OR G02B27/0176 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02B2027/0118 OR G02B2027/0127 OR G02B27/0101 OR G02B27/0081 OR G02B27/4205 OR G02B2027/0105 OR G02B2027/0185 OR G02B27/0179 OR G02B27/42 OR G02B27/4227 OR G02B6/10 OR G02B6/0038 OR G02B6/005 OR G02B6/0076 OR G02B7/008 OR G02B27/283 OR G02B2027/0114 OR G02B2027/012 OR G02B2027/0125 OR G02B2027/0174 OR G02B27/0018 OR G02B27/1086 OR G02B27/30 OR G02B5/1823 OR G02B5/1857 OR G02B5/1866 OR G02B5/1871 OR G02B5/3025 OR G02B6/0016 OR G02B6/0023 OR G02B6/0035 OR G02B6/0036 OR G02B6/29325 OR G02B5/30 OR G02B2027/0132 OR G02B2027/0134 OR G02B2027/0156 OR G02B2027/0123 OR G02B21/06 OR G02B21/365 OR G02B27/286 OR G02B30/52 OR G02B27/01 OR G02B6/0018 OR G02B6/002 OR G02B2027/0147 OR G02B2027/015 OR G02B27/0149 OR G02B6/0053 OR G02B2027/0112 OR G02B2027/0141 OR G02B2027/0152 OR G02B2027/0161 OR G02B5/18 OR G02B6/00 OR G02B6/12009 OR G02B7/12 OR G02B2027/011 OR					

		G02B2027/0154 OR G02B2207/113 OR G02B2207/115 OR G02B27/0075 OR G02B5/23 OR G02B5/3058 OR G02B6/0028 OR G02B6/003 OR G02B6/0045 OR G02B6/0056 OR G02B6/006 OR G02B6/0065 OR G02B6/0068 OR G02B6/0088 OR G02B6/12019 OR G02B2027/013 OR G02B2027/0163 OR G02B2027/0181 OR G02B2027/019 OR G02B27/0189 OR G02B30/26 OR G02B5/04 OR G02B5/1842 OR G02B5/28 OR G02B6/32 OR G02B6/3512).cpc.)					
L950	120	L47 AND ((G02C11/10 OR G02C11/06 OR G02C5/143 OR G02C5/14 OR G02C3/003 OR G02C5/001 OR G02C5/146 OR G02C2200/08 OR G02C5/16 OR G02C11/00 OR G02C11/04 OR G02C7/08 OR G02C7/081 OR G02C7/086 OR G02C9/00 OR G02C9/04 OR G02C2200/02 OR G02C2202/06 OR G02C5/045 OR G02C5/2209 OR G02C7/083 OR G02C7/101 OR G02C5/12 OR G02C13/005 OR G02C5/22 OR G02C5/2254 OR G02C5/2281 OR G02C7/022 OR G02C7/04 OR G02C9/02).cpc.)	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L951	108	L48 AND (	(US-PGPUB; USPAT;	OR	ON	ON	2022/12/05

		(G02B2027/0178 OR G02B27/017 OR G02B27/0093 OR G02B2027/014 OR G02B27/0172 OR G02B2027/0138 OR G02B2027/0187 OR G02B2027/0118 OR G02B5/30 OR G02B27/0176 OR G02B21/06 OR G02B21/365 OR G02B27/286 OR G02B2027/0134 OR G02B2027/0132 OR G02B2027/0147 OR G02B6/0053 OR G02B2027/0112 OR G02B2027/0127 OR G02B27/0149 OR G02B5/18 OR G02B6/12009 OR G02B2027/011 OR G02B2027/0123 OR G02B2027/0141 OR G02B2027/0156 OR G02B2207/113 OR G02B2207/115 OR G02B27/0075 OR G02B27/01 OR G02B27/0101 OR G02B5/23 OR G02B5/3058 OR G02B6/0018 OR G02B6/002 OR G02B6/0028 OR G02B6/003 OR G02B6/0038 OR G02B6/0045 OR G02B6/005 OR G02B6/0056 OR G02B6/006 OR G02B6/0065 OR G02B6/0068 OR G02B6/0076 OR G02B6/0088 OR G02B6/12019 OR G02B7/008 OR G02B27/0081 OR G02B5/04 OR G02B5/1842 OR G02B5/28).cpc.)	USOCR; EPO; JPO; DERWENT)				03:07 PM
L952	82	L48 AND ((G02C11/10 OR G02C11/06 OR G02C5/143 OR G02C5/14 OR G02C3/003 OR G02C5/146 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02C5/001 OR G02C2200/08 OR G02C11/04 OR G02C11/00 OR G02C7/081 OR G02C7/08 OR G02C7/086 OR G02C9/00 OR G02C2202/06 OR G02C5/2209 OR G02C7/083 OR G02C7/101 OR G02C9/04 OR G02C5/12 OR G02C5/22 OR G02C5/2254 OR G02C5/2281).cpc.)					
L953	7	L50 AND ((G02B2027/0178 OR G02B27/017 OR G02B27/0093 OR G02B2027/014 OR G02B27/0172 OR G02B2027/0138 OR G02B2027/0187 OR G02B2027/0118 OR G02B5/30 OR G02B27/0176 OR G02B2027/0134 OR G02B2027/0147 OR G02B2027/0112 OR G02B2027/0127 OR G02B2027/0132 OR G02B27/0149 OR G02B5/18 OR G02B6/12009 OR G02B2027/011 OR G02B2027/0123 OR G02B2207/113 OR G02B2207/115 OR G02B5/23 OR G02B5/3058 OR G02B6/0038 OR G02B6/0045 OR G02B6/0053 OR G02B6/0056 OR G02B6/12019 OR G02B7/008 OR G02B5/04 OR G02B5/1842 OR G02B5/28).cpc.)	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L954	7	L50 AND ((G02C11/10 OR G02C11/06 OR G02C5/146 OR G02C5/143 OR G02C2200/08 OR G02C5/001 OR	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

		G02C11/04 OR G02C5/14 OR G02C7/081 OR G02C7/08 OR G02C7/086 OR G02C9/00 OR G02C2202/06 OR G02C5/2209 OR G02C7/083 OR G02C7/101).cpc.)					
L955	6	L50 AND ((351/158 OR 351/121 OR 351/41 OR 351/116 OR 351/119 OR 359/630 OR 359/13 OR 359/554 OR 359/567 OR 381/327 OR 381/381).ccls.)	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L956	3422	(351/158,121).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L957	2559	(351/41,111).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L958	996	(351/123,124).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L959	3324	(359/13,629).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L960	5242	(359/630-633).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L961	3348	(381/381,327,328).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L962	3971	(381/380,370,381).ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L963	5197114	29 AND 90	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L964	3754867	29 AND 92	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L965	3505315	29 AND 94	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L966	3580721	29 AND 96	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L967	4852007	46 AND 90	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM

L968	3765238	46 AND 92	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L969	3535515	46 AND 94	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L970	3542414	46 AND 96	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L971	315	g02c1/00.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L972	5113	g02c11/10.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L973	948	g02c11/06.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L974	1106	g02c5/001.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L975	1626	g02c5/02.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L976	1045	g02c5/14.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L977	1443	g02c5/146.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L978	1328	g02c5/22.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L979	8777	g02b27/01.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L980	24110	g02b27/017.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L981	8234	g02b27/0176.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/12/05 03:07 PM
L982	4	"16821810"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/12/05 03:07 PM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L983	3423	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND speaker$2 AND (sound WITH guid$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L984	1225	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND (speaker$2 SAME (sound WITH guid$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L985	472	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND temple AND ((speaker$2 OR audio) SAME (sound WITH guid$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L986	45	(Artificial Intelligence) More like doc: JP-2005167902-A	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/12/05 03:07 PM

		Text: (JP-2007318476-A OR JP-4887907-B2 OR JP-2009157290-A OR JP-2004120154-A OR US-8174569-B2 OR US-20070291966-A1 OR JP-WO2007037089-A1 OR WO-2012105432-A1 OR JP-2010230701-A OR WO-03023756-A1 OR EP-1433160-A1 OR RU-2572049-C2 OR JP-2006209144-A OR WO-2018186062-A1 OR US-20200053449-A1 OR JP-WO2018186062-A1 OR US-11109137-B2 OR JP-7088172-B2 OR JP-2007266870-A OR CN-110463221-B).did.	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L987	223	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND ((temples SAME speakers) AND (sound WITH guid$4))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L988	10436	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND temple AND (speakers AND audio)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L989	984	(eyewear$4 OR glasses$4 OR spetacl$4 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY,	OR	ON	ON	2022/12/05 03:07 PM

		eyegalss$4) AND (temple SAME (speakers WITH audio))	CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1004	135589	739 740 741 742 743 744 745 746 747 748 749	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L1005	1031	854 AND 689	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L1006	183	854 AND 693	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK,	OR	ON	ON	2022/12/05 03:07 PM

			TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1007	29	854 AND 694	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:07 PM
L1040	24831	(G02C11/10 OR G02C5/001 OR G02C5/14 OR G02C11/06 OR G02C5/143).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:41 PM
L1041	705	1034 AND 926	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:41 PM
L1042	460	1034 AND 927	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2022/12/05 03:41 PM

			EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1043	171	1034 AND 929	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:41 PM
L1044	107	1034 AND 930	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 03:41 PM
L1045	95	1034 AND 987	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	OR	ON	ON	2022/12/05 03:41 PM

			JPO; DERWENT; IBM_TDB)				
L1046	46	(Artificial Intelligence) Similar to: 17/873,104 with 0 CPC Selections and 2 Text Selections Text: (US-20200218094-A1 OR US-20220357599-A1 OR DE-202013100094-U1 OR JP-H10503340-A OR US-20220011603-A1 OR US-20090175482-A1 OR WO-2004016037-A1 OR CN-102792713-B OR CN-203435105-U OR US-20150245131-A1 OR US-11474376-B2 OR WO-2012044254-A1 OR AU-2011307614-B2 OR EP-2622877-A1 OR AU-2011307614-A1 OR WO-2013019893-A1 OR US-20170085976-A1 OR US-9301057-B2 OR WO-9807298-A1 OR US-20140192996-A1 OR US-20220264242-A1 OR EP-3496417-A2 OR JP-2013143780-A OR US-20070116318-A1 OR US-20170164092-A1 OR US-5563951-A OR US-20190174237-A1 OR US-6091832-A OR WO-2010126550-A1 OR US-20100272304-A1 OR CN-103200413-A OR JP-5856090-B2 OR KR-20130099972-A OR US-20130293448-A1 OR US-20060132382-A1 OR US-20040156012-A1 OR WO-2021024747-A1 OR CN-109922417-B OR US-20040160573-A1 OR US-20170090219-A1 OR US-20170019727-A1 OR JP-2004504785-A OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2022/12/05 04:53 PM

		20060197907-A1 OR US-20120220234-A1 OR US-20170208381-A1 OR CN-103200413-B OR US-9525936-B1 OR US-20180335650-A1 OR US-20040157649-A1 OR US-20190373352-A1).did.					
L1047	43	(Artificial Intelligence) Similar to: 17/873,104 with 2 CPC Selections and 2 Text Selections Text: (FR-2984534-A1 OR ES-1289195-U OR FR-3015057-A1 OR EP-3143460-B1 OR FR-3027412-A1 OR CH-707274-B9 OR CH-707274-B1 OR DE-102009014114-B4 OR DE-102009014114-A1 OR ES-2707523-T3 OR KR-0113267-Y1 OR CA-3030910-A1 OR EP-2233965-B1 OR US-10659868-B1 OR EP-2233965-A1 OR GB-834268-A OR US-20200142222-A1 OR DE-202022101915-U1 OR DK-2233965-T3 OR WO-2007093125-A1 OR US-3076062-A OR DE-2118569-A1 OR GB-857316-A OR US-20190113774-A1 OR US-7103192-B2 OR US-20050074137-A1 OR DK-3143460-T3 OR US-20190204617-A1 OR US-20210341761-A1 OR US-3396245-A OR JP-3237752-U OR WO-2018224308-A1 OR EP-3635476-A1 OR JP-S5588497-A OR US-3244819-A OR US-3048668-A OR WO-2004012477-A3 OR EP-3455670-A1 OR WO-2017196294-A1 OR US-9525936-B1 OR TW-I774573-B OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2022/12/05 04:53 PM

		3116376-A OR DE-102005062577-B3 OR US-20220146860-A1 OR US-20160142830-A1 OR US-6148087-A OR JP-2020053948-A OR US-20060197907-A1 OR CN-101022681-A OR KR-20200014891-A).did.					
L1048	43	(Artificial Intelligence) Similar to: 17/873,104 with 5 CPC Selections and 2 Text Selections Text: (US-9547184-B2 OR US-11243416-B2 OR US-10061144-B2 OR US-20190113774-A1 OR EP-3455670-A1 OR WO-2017196294-A1 OR US-20200285069-A1 OR US-10379386-B2 OR CN-105229737-B OR CN-105229737-A OR EP-2973556-B1 OR US-20200218094-A1 OR US-11204512-B2 OR US-9810925-B2 OR US-20140278385-A1 OR EP-2973556-A1 OR WO-2014163797-A1 OR US-20220113562-A1 OR WO-2007093125-A1 OR US-11156855-B2 OR JP-2016516343-A OR US-20220011603-A1 OR GB-2594812-A OR WO-2020038485-A1 OR US-20180045982-A1 OR KR-20050093003-A OR US-9525936-B1 OR CN-216145034-U OR JP-6375362-B2 OR TW-I624829-B OR US-6148087-A OR WO-2020144536-A3 OR WO-2020144536-A2 OR EP-2387252-A1 OR AU-2009319620-A1 OR US-8905542-B2 OR CN-101022681-A OR US-9033493-B2 OR US-20070246768-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2022/12/05 04:54 PM

		OR KR-20210058039-A OR CN-101753221-A OR US-20210168482-A1 OR WO-2010060323-A1 OR TW-201510990-A OR DE-10339027-A1 OR US-20110224481-A1 OR US-20220357599-A1 OR WO-2007110551-A1 OR EP-1998729-A1 OR EP-3143460-B1).did.					
L1049	44	(Artificial Intelligence) Similar to: 17/873,104 with 5 CPC Selections and 1 Text Selection Text: (US-9547184-B2 OR US-11243416-B2 OR US-10061144-B2 OR CN-105229737-B OR US-20200285069-A1 OR US-10379386-B2 OR CN-105229737-A OR EP-2973556-B1 OR US-9810925-B2 OR US-20140278385-A1 OR EP-2973556-A1 OR WO-2014163797-A1 OR JP-2016516343-A OR GB-2594812-A OR KR-20050093003-A OR WO-2007093125-A1 OR WO-2020038485-A1 OR US-11204512-B2 OR US-20070246768-A1 OR KR-20210058039-A OR JP-6375362-B2 OR US-20180045982-A1 OR WO-2020144536-A3 OR US-20190113774-A1 OR CN-216145034-U OR ES-1289195-U OR US-6148087-A OR CN-101042869-A OR CN-101022681-A OR TW-I624829-B OR US-20210168482-A1 OR EP-3143460-B1 OR EP-3455670-A1 OR WO-2017196294-A1 OR TW-201510990-A OR DE-10339027-A1 OR WO-2007110551-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2022/12/05 04:54 PM

		A1 OR EP-1998729-A1 OR CN-114545655-A OR WO-2020144536-A2 OR US-11156855-B2 OR CN-101753221-A OR WO-2010060323-A1 OR FR-2915815-A1 OR FR-2984534-A1 OR US-9033493-B2 OR US-20220113562-A1 OR FR-3015057-A1 OR US-20110224481-A1 OR FR-3027412-A1).did.					
L1050	43	(Artificial Intelligence) Similar to: 17/873,104 with 5 CPC Selections and 3 Text Selections Text: (US-9547184-B2 OR US-11243416-B2 OR US-10061144-B2 OR US-20190113774-A1 OR EP-3455670-A1 OR WO-2017196294-A1 OR US-20200285069-A1 OR US-10379386-B2 OR CN-105229737-B OR CN-105229737-A OR EP-2973556-B1 OR US-20200218094-A1 OR US-11204512-B2 OR US-9810925-B2 OR US-20140278385-A1 OR EP-2973556-A1 OR WO-2014163797-A1 OR US-20220113562-A1 OR WO-2007093125-A1 OR US-11156855-B2 OR JP-2016516343-A OR US-20220011603-A1 OR GB-2594812-A OR WO-2020038485-A1 OR US-20180045982-A1 OR KR-20050093003-A OR US-9525936-B1 OR CN-216145034-U OR JP-6375362-B2 OR TW-I624829-B OR US-6148087-A OR WO-2020144536-A3 OR WO-2020144536-A2 OR EP-2387252-A1 OR AU-2009319620-A1 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2022/12/05 04:56 PM

		US-8905542-B2 OR CN-101022681-A OR US-9033493-B2 OR US-20070246768-A1 OR KR-20210058039-A OR CN-101753221-A OR US-20210168482-A1 OR WO-2010060323-A1 OR TW-201510990-A OR DE-10339027-A1 OR US-20110224481-A1 OR US-20220357599-A1 OR WO-2007110551-A1 OR EP-1998729-A1 OR EP-3143460-B1).did.					
L1051	283	(US-20010005230-$ | US-20010028309-$ | US-20010050754-$ | US-20020017997-$ | US-20020021407-$ | US-20020081982-$ | US-20020084990-$ | US-20020089639-$ | US-20020090103-$ | US-20020098877-$ | US-20020101568-$ | US-20020109600-$ | US-20020140899-$ | US-20020159023-$ | US-20020197961-$ | US-20030018274-$ | US-20030022690-$ | US-20030032449-$ | US-20030062046-$ | US-20030065257-$ | US-20030067585-$ | US-20030068057-$ | US-20030083591-$ | US-20030214630-$ | US-20030226978-$ | US-20030231293-$ | US-20040000733-$ | US-20040029582-$ | US-20040059212-$ | US-20040063378-$ | US-20040096078-$ | US-20040100384-$ | US-20040101178-$ | US-20040128737-$ | US-20040150986-$ | US-20040156012-$ | US-20040157649-$ | US-20040160571-$ | US-20040160572-$ | US-20040160573-$ | US-20040197002-$ |	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:15 PM

		US-20040227219-$ |					
		US-20050067580-$ |					
		US-20050078274-$ |					
		US-20050088365-$ |					
		US-20050201585-$ |					
		US-20050213026-$ |					
		US-20050230596-$ |					
		US-20050238194-$ |					
		US-20050239502-$ |					
		US-20050248717-$ |					
		US-20050248718-$ |					
		US-20050248719-$ |					
		US-20050264752-$ |					
		US-20060001827-$ |					
		US-20060003803-$ |					
		US-20060023158-$ |					
		US-20060034478-$ |					
		US-20060107822-$ |					
		US-20060132382-$ |					
		US-20070030442-$ |					
		US-20070035830-$ |					
		US-20070046887-$ |					
		US-20070055888-$ |					
		US-20070098192-$ |					
		US-20070109491-$ |					
		US-20070186330-$ |					
		US-20070200927-$ |					
		US-20070208531-$ |					
		US-20070248238-$ |					
		US-20070270663-$ |					
		US-20070271065-$ |					
		US-20070271116-$ |					
		US-20070271387-$ |					
		US-20070279584-$ |					
		US-20080062338-$ |					
		US-20080068559-$ |					
		US-20080100792-$ |					
		US-20080144854-$ |					
		US-20080151175-$ |					
		US-20080151179-$ |					
		US-20080158506-$ |					
		US-20080218684-$ |					
		US-20080262392-$ |					
		US-20080278678-$ |					
		US-20090059159-$ |					
		US-20090059381-$ |					
		US-20090073375-$ |					
		US-20090141233-$ |					
		US-20090147215-$ |					
		US-20090156128-$ |					
		US-20090251660-$ |					
		US-20090251661-$ |					
		US-20090296044-$ |					
		US-20100061579-$ |					
		US-20100079356-$ |					
		US-20100110368-$ |					
		US-20100245754-$ |					
		US-20100296045-$ |					

		US-20100309426-$ | US-20110102734-$ | US-20110164122-$ | US-20110187990-$ | US-20110241976-$ | US-20110273365-$ | US-20120033061-$ | US-20120050668-$ | US-20120133885-$ | US-20120176580-$ | US-20130072828-$ | US-20130077175-$ | US-20130143519-$ | US-20130201440-$ | US-20130308089-$ | US-20140132913-$ | US-20140176902-$ | US-20140198293-$ | US-20140268008-$ | US-20140268013-$ | US-20140268017-$ | US-20140361185-$ | US-20150085245-$ | US-20150230988-$ | US-20150253590-$ | US-20160246075-$ | US-20160302992-$ | US-20170068117-$ | US-20170074721-$ | US-20170090219-$ | US-20170131575-$ | US-20170146829-$ | US-20170303187-$ | US-20180314079-$ | US-20180335650-$ | US-20180348050-$ | US-20190033623-$ | US-20190187492-$ | US-20190272800-$ | US-20190278110-$ | US-20190285913-$ | US-20190310132-$ | US-20190318589-$ | US-20190387351-$ | US-20200218094-$ | US-20200364992-$).DID.					
L1052	536	("197708" | "198608" | "198805" | "198909" | "99411" | "199511" | "199609" | "199709" | "199807" | "200011" | "200101" | "200102" | "200205" | "200208" | "200210" | "200302" | "200512" | "200907" | "1129988" | "6081194" | "681194" | "7312791" |	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/12/05 05:15 PM

		"8237349" | "2107638").DID.	RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1053	383	(US-10042186-$ | US-10060790-$ | US-10061144-$ | US-10310296-$ | US-10345625-$ | US-10359311-$ | US-10359459-$ | US-10624790-$ | US-10777048-$ | US-11042045-$ | US-1255265-$ | US-1917745-$ | US-2249572-$ | US-2638532-$ | US-2794085-$ | US-2818511-$ | US-2830132-$ | US-2874230-$ | US-2904670-$ | US-3060308-$ | US-3597054-$ | US-3710115-$ | US-3858001-$ | US-3883701-$ | US-4165487-$ | US-4254451-$ | US-4283127-$ | US-4322585-$ | US-4348664-$ | US-4389217-$ | US-4526473-$ | US-4535244-$ | US-4608492-$ | US-4683587-$ | US-4751691-$ | US-4757714-$ | US-4773095-$ | US-4806011-$ | US-4822160-$ | US-4822161-$ | US-4851686-$ | US-4856086-$ | US-4859047-$ | US-4882769-$ | US-4904078-$ | US-4942629-$ | US-4962469-$ | US-4967268-$ | US-4985632-$ | US-5008548-$ | US-5015086-$ | US-5020150-$ | US-5026151-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:16 PM

		5036311-$ | US- 5050150-$ | US- 5064410-$ | US- 5093576-$ | US- 5106179-$ | US- 5148023-$ | US- 5151600-$ | US- 5161250-$ | US- 5172256-$ | US- 5264877-$ | US- 5306917-$ | US- 5353378-$ | US- 5359370-$ | US- 5359444-$ | US- 5367345-$ | US- 5379464-$ | US- 5382986-$ | US- 5394005-$ | US- 5452026-$ | US- 5452480-$ | US- 5455637-$ | US- 5455640-$ | US- 5457751-$ | US- 5463428-$ | US- 5500532-$ | US- 5510961-$ | US- 5513384-$ | US- 5533130-$ | US- 5541641-$ | US- 5581090-$ | US- 5585871-$ | US- 5589398-$ | US- 5590417-$ | US- 5606743-$ | US- 5608808-$ | US- 5634201-$ | US- 5671035-$ | US- 5686727-$ | US- 5694475-$ | US- 5715323-$ | US- 5737436-$ | US- 5818381-$ | US- 5835185-$ | US- 5900720-$ | US- 5903395-$ | US- 5923398-$ | US- 5941837-$ | US- 5946071-$ | US- 5949516-$ | US- 5966746-$ | US- 5980037-$ | US- 5988812-$ | US- 5991085-$ | US- 5992996-$ | US- 5995592-$ | US- 6010216-$ | US- 6013919-$ | US- 6028627-$ | US-					

		6046455-$ | US- 6060321-$ | US- 6061580-$ | US- 6091546-$ | US- 6091832-$ | US- 6115177-$ | US- 6132681-$ | US- 6145983-$ | US- 6154552-$ | US- 6176576-$ | US- 6225897-$ | US- 6231181-$ | US- 6236969-$ | US- 6243578-$ | US- 6259367-$ | US- 6270466-$ | US- 6292213-$ | US- 6292685-$ | US- 6301367-$ | US- 6307526-$ | US- 6343858-$ | US- 6349001-$ | US- 6349422-$ | US- 6409335-$ | US- 6409338-$ | US- 6426719-$ | US- 6431705-$ | US- 6474816-$ | US- 6478736-$ | US- 6506142-$ | US- 6511175-$ | US- 6513532-$ | US- 6517203-$ | US- 6539336-$ | US- 6542081-$ | US- 6546101-$ | US- 6554763-$ | US- 6582075-$ | US- 6619799-$ | US- 6629076-$ | US- 6729726-$ | US- 6736759-$ | US- 6764194-$ | US- 6769767-$ | US- 6788309-$ | US- 6792401-$ | US- 6816314-$ | US- 6824265-$ | US- 6857741-$ | US- 6871951-$ | US- 6879930-$ | US- 6912386-$ | US- 6929365-$ | US- 6932090-$ | US- 6947219-$ | US- 7004582-$ | US- 7013009-$ | US- 7023594-$ | US-					

		7030902-$ | US- 7031667-$ | US- 7033025-$ | US- 7059717-$ | US- 7073905-$ | US- 7079876-$ | US- 7123215-$ | US- 7192136-$ | US- 7255437-$ | US- 7265358-$ | US- 7274292-$ | US- 7289767-$ | US- 7312699-$ | US- 7331666-$ | US- 7376238-$ | US- 7380936-$ | US- 7401918-$ | US- 7405801-$ | US- 7429965-$ | US- 7438409-$ | US- 7438410-$ | US- 7445332-$ | US- 7481531-$ | US- 7500746-$ | US- 7500747-$ | US- 7512414-$).DID.					
L1054	381	(US-20190310132-$ | US-20190318589-$ | US-20190387351-$ | US-20200012127-$ | US-20200218094-$ | US-20200364992-$ | US-3060308-$ | US-3597054-$ | US-3710115-$ | US-3858001-$ | US-3883701-$ | US-4165487-$ | US-4254451-$ | US-4283127-$ | US-4322585-$ | US-4348664-$ | US-4389217-$ | US-4526473-$ | US-4535244-$ | US-4608492-$ | US-4683587-$ | US-4751691-$ | US-4757714-$ | US-4773095-$ | US-4806011-$ | US-4822160-$ | US-4822161-$ | US-4851686-$ | US-4856086-$ | US-4859047-$ | US-4882769-$ | US-4904078-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:16 PM

		4942629-$ | US- 4962469-$ | US- 4967268-$ | US- 4985632-$ | US- 5008548-$ | US- 5015086-$ | US- 5020150-$ | US- 5026151-$ | US- 5036311-$ | US- 5050150-$ | US- 5064410-$ | US- 5093576-$ | US- 5106179-$ | US- 5148023-$ | US- 5151600-$ | US- 5161250-$ | US- 5172256-$ | US- 5264877-$ | US- 5306917-$ | US- 5353378-$ | US- 5359370-$ | US- 5359444-$ | US- 5367345-$ | US- 5379464-$ | US- 5382986-$ | US- 5394005-$ | US- 5452026-$ | US- 5452480-$ | US- 5455637-$ | US- 5455640-$ | US- 5457751-$ | US- 5463428-$ | US- 5500532-$ | US- 5510961-$ | US- 5513384-$ | US- 5533130-$ | US- 5541641-$ | US- 5581090-$ | US- 5585871-$ | US- 5589398-$ | US- 5590417-$ | US- 5606743-$ | US- 5608808-$ | US- 5634201-$ | US- 5671035-$ | US- 5686727-$ | US- 5694475-$ | US- 5715323-$ | US- 5737436-$ | US- 5818381-$ | US- 5835185-$ | US- 5900720-$ | US- 5903395-$ | US- 5923398-$ | US- 5941837-$ | US- 5946071-$ | US- 5949516-$ | US- 5966746-$ | US-					

		5980037-$ | US- 5988812-$ | US- 5991085-$ | US- 5992996-$ | US- 5995592-$ | US- 6010216-$ | US- 6013919-$ | US- 6028627-$ | US- 6046455-$ | US- 6060321-$ | US- 6061580-$ | US- 6091546-$ | US- 6091832-$ | US- 6115177-$ | US- 6132681-$ | US- 6145983-$ | US- 6154552-$ | US- 6176576-$ | US- 6225897-$ | US- 6231181-$ | US- 6236969-$ | US- 6243578-$ | US- 6259367-$ | US- 6270466-$ | US- 6292213-$ | US- 6292685-$ | US- 6301367-$ | US- 6307526-$ | US- 6343858-$ | US- 6349001-$ | US- 6349422-$ | US- 6409335-$ | US- 6409338-$ | US- 6426719-$ | US- 6431705-$ | US- 6474816-$ | US- 6478736-$ | US- 6506142-$ | US- 6511175-$ | US- 6513532-$ | US- 6517203-$ | US- 6539336-$ | US- 6542081-$ | US- 6546101-$ | US- 6554763-$ | US- 6582075-$ | US- 6619799-$ | US- 6629076-$ | US- 6729726-$ | US- 6736759-$ | US- 6764194-$ | US- 6769767-$ | US- 6788309-$ | US- 6792401-$ | US- 6816314-$ | US- 6824265-$ | US- 6857741-$ | US- 6871951-$ | US-					

		6879930-$ | US- 6912386-$ | US- 6929365-$ | US- 6932090-$ | US- 6947219-$ | US- 7004582-$ | US- 7013009-$ | US- 7023594-$ | US- 7030902-$ | US- 7031667-$ | US- 7033025-$ | US- 7059717-$ | US- 7073905-$ | US- 7079876-$ | US- 7123215-$ | US- 7192136-$ | US- 7255437-$ | US- 7265358-$ | US- 7274292-$ | US- 7289767-$ | US- 7312699-$ | US- 7331666-$ | US- 7376238-$ | US- 7380936-$ | US- 7401918-$ | US- 7405801-$ | US- 7429965-$ | US- 7438409-$ | US- 7438410-$ | US- 7445332-$ | US- 7481531-$ | US- 7500746-$ | US- 7500747-$ | US- 7512414-$ | US- 7517083-$ | US- 7527374-$ | US- 7543934-$ | US- 7581833-$ | US- 7621634-$ | US- 7648236-$ | US- 7677723-$ | US- 7760898-$ | US- 7771046-$ | US- 7792552-$ | US- 7806525-$ | US- 7922321-$).DID.				
L1055	1188	1051 1052 1053 1054	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK,	OR	ON	ON	2022/12/05 05:17 PM

			TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1056	41	1055 AND 927	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:17 PM
L1057	21	1055 AND 930	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:18 PM
L1058	18	1055 AND 987	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:18 PM
L1059	3	"20040160573"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2022/12/05 05:38 PM

			EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1060	3	"20050264752"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:38 PM
L1061	11	"20040000733"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:38 PM
L1062	3	"20050201585"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	OR	ON	ON	2022/12/05 05:38 PM

			JPO; DERWENT; IBM_TDB)				
L1063	2	"20070248238"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:39 PM
L1064	3	"20040156012"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:39 PM
L1065	164	"7278734"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:51 PM
L1066	35	"9122082"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2022/12/05 05:51 PM

			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1067	47	"10061144"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:52 PM
L1068	31	"11204512"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:53 PM
L1069	27	"10628831"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:53 PM

L1070	61	"11183269"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/05 05:53 PM
L1071	301	(US-1255265-$ | US-1917745-$ | US-10042186-$ | US-10060790-$ | US-10061144-$ | US-10310296-$ | US-10345625-$ | US-10359311-$ | US-10539459-$ | US-10624790-$ | US-10777048-$ | US-11042045-$ | US-2249572-$ | US-2638532-$ | US-2794085-$ | US-2818511-$ | US-2830132-$ | US-2874230-$ | US-2904670-$ | US-20010005230-$ | US-20010028309-$ | US-20010050754-$ | US-20020017997-$ | US-20020021407-$ | US-20020081982-$ | US-20020084990-$ | US-20020090103-$ | US-20020098877-$ | US-20020101568-$ | US-20020109600-$ | US-20020140899-$ | US-20020159023-$ | US-20020197961-$ | US-20030018274-$ | US-20030022690-$ | US-20030032449-$ | US-20030062046-$ | US-20030065257-$ | US-20030067585-$ | US-20030068057-$ | US-20030083591-$ | US-20030214630-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:04 AM

		20030226978-$ | US- 20030231293-$ | US- 20040000733-$ | US- 20040029582-$ | US- 20040059212-$ | US- 20040063378-$ | US- 20040096078-$ | US- 20040100384-$ | US- 20040101178-$ | US- 20040128737-$ | US- 20040150986-$ | US- 20040156012-$ | US- 20040157649-$ | US- 20040160571-$ | US- 20040160572-$ | US- 20040160573-$ | US- 20040197002-$ | US- 20040227219-$ | US- 20050067580-$ | US- 20050078274-$ | US- 20050088365-$ | US- 20050201585-$ | US- 20050213026-$ | US- 20050230596-$ | US- 20050238194-$ | US- 20050239502-$ | US- 20050248717-$ | US- 20050248718-$ | US- 20050248719-$ | US- 20050264752-$ | US- 20060001827-$ | US- 20060003803-$ | US- 20060023158-$ | US- 20060034478-$ | US- 20060107822-$ | US- 20060132382-$ | US- 20070030442-$ | US- 20070035830-$ | US- 20070046887-$ | US- 20070055888-$ | US- 20070098192-$ | US- 20070109491-$ | US- 20070186330-$ | US- 20070200927-$ | US- 20070208531-$ | US- 20070248238-$ | US- 20070270663-$ | US- 20070271065-$ | US- 20070271116-$ | US- 20070271387-$ | US- 20070279584-$ | US- 20080062338-$ | US- 20080068559-$ | US- 20080100792-$ | US- 20080144854-$ | US- 20080151175-$ | US- 20080151179-$ | US- 20080158506-$ | US-					

		20080218684-$ | US- 20080262392-$ | US- 20080278678-$ | US- 20090059159-$ | US- 20090059381-$ | US- 20090073375-$ | US- 20090141233-$ | US- 20090147215-$ | US- 20090156128-$ | US- 20090251660-$ | US- 20090251661-$ | US- 20090296044-$ | US- 20100061579-$ | US- 20100079356-$ | US- 20100110368-$ | US- 20100245754-$ | US- 20100296045-$ | US- 20100309426-$ | US- 20110102734-$ | US- 20110164122-$ | US- 20110187990-$ | US- 20110241976-$ | US- 20110273365-$ | US- 20120033061-$ | US- 20120050668-$ | US- 20120133885-$ | US- 20120176580-$ | US- 20130072828-$ | US- 20130077175-$ | US- 20130143519-$ | US- 20130201440-$ | US- 20130308089-$ | US- 20140132913-$ | US- 20140176902-$ | US- 20140198293-$ | US- 20140268008-$ | US- 20140268013-$ | US- 20140268017-$ | US- 20140361185-$ | US- 20150085245-$ | US- 20150230988-$ | US- 20150253590-$ | US- 20160246075-$ | US- 20160302992-$ | US- 20170068117-$ | US- 20170074721-$ | US- 20170090219-$ | US- 20170131575-$ | US- 20170146829-$ | US- 20170303187-$ | US- 20180314079-$ | US- 20180335650-$ | US- 20180348050-$ | US- 20190033623-$ | US- 20190187492-$ | US- 20190272800-$ | US- 20190278110-$ | US- 20190285913-$).DID.					

L1072	354	(US-20060132382-$ | US-20070030442-$ | US-20070035830-$ | US-20070046887-$ | US-20070055888-$ | US-20070098192-$ | US-20070109491-$ | US-20070186330-$ | US-20070200927-$ | US-20070208531-$ | US-20070270663-$ | US-20070271065-$ | US-20070271116-$ | US-20070271387-$ | US-20070279584-$ | US-20080062338-$ | US-20080068559-$ | US-20080144854-$ | US-20080151175-$ | US-20080151179-$ | US-20080158506-$ | US-20080218684-$ | US-20080262392-$ | US-20080278678-$ | US-20090059159-$ | US-20090073375-$ | US-20090141233-$ | US-20090147215-$ | US-20090156128-$ | US-20090251661-$ | US-20090296044-$ | US-20100061579-$ | US-20100079356-$ | US-20100110368-$ | US-20100245754-$ | US-20100296045-$ | US-20100309426-$ | US-20110102734-$ | US-20110164122-$ | US-20110187990-$ | US-20110241976-$ | US-20110273365-$ | US-20120033061-$ | US-20120050668-$ | US-20120133885-$ | US-20130072828-$ | US-20130201440-$ | US-20130308089-$ | US-20140132913-$ | US-20140176902-$ | US-20140198293-$ | US-20140268008-$ | US-20140268013-$ | US-20140268017-$ | US-20140361185-$ | US-20150085245-$ | US-20150230988-$ | US-20150253590-$ |	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:04 AM

		US-20160246075-$ | US-20160302992-$ | US-20170068117-$ | US-20170074721-$ | US-20170131575-$ | US-20170146829-$ | US-2249572-$ | US-2638532-$ | US-2794085-$ | US-2818511-$ | US-2830132-$ | US-2874230-$ | US-2904670-$ | US-3060308-$ | US-3597054-$ | US-3710115-$ | US-3858001-$ | US-3883701-$ | US-4165487-$ | US-4254451-$ | US-4283127-$ | US-4322585-$ | US-4348664-$ | US-4389217-$ | US-4526473-$ | US-4535244-$ | US-4608492-$ | US-4683587-$ | US-4751691-$ | US-4757714-$ | US-4773095-$ | US-4806011-$ | US-4822160-$ | US-4822161-$ | US-4851686-$ | US-4856086-$ | US-4859047-$ | US-4882769-$ | US-4904078-$ | US-4942629-$ | US-4962469-$ | US-4967268-$ | US-4985632-$ | US-5008548-$ | US-5015086-$ | US-5020150-$ | US-5026151-$ | US-5036311-$ | US-5050150-$ | US-5064410-$ | US-5093576-$ | US-5106179-$ | US-5148023-$ | US-5151600-$ | US-5161250-$ | US-5172256-$ | US-5264877-$ | US-5306917-$ | US-						

		5353378-$ | US- 5359370-$ | US- 5359444-$ | US- 5367345-$ | US- 5379464-$ | US- 5382986-$ | US- 5394005-$ | US- 5452026-$ | US- 5452480-$ | US- 5455637-$ | US- 5455640-$ | US- 5457751-$ | US- 5463428-$ | US- 5500532-$ | US- 5510961-$ | US- 5513384-$ | US- 5533130-$ | US- 5541641-$ | US- 5581090-$ | US- 5585871-$ | US- 5589398-$ | US- 5590417-$ | US- 5606743-$ | US- 5608808-$ | US- 5634201-$ | US- 5671035-$ | US- 5686727-$ | US- 5694475-$ | US- 5715323-$ | US- 5737436-$ | US- 5818381-$ | US- 5835185-$ | US- 5900720-$ | US- 5903395-$ | US- 5941837-$ | US- 5946071-$ | US- 5949516-$ | US- 5966746-$ | US- 5980037-$ | US- 5988812-$ | US- 5991085-$ | US- 5992996-$ | US- 5995592-$ | US- 6010216-$ | US- 6013919-$ | US- 6028627-$ | US- 6046455-$ | US- 6060321-$ | US- 6061580-$ | US- 6091546-$ | US- 6091832-$ | US- 6115177-$ | US- 6132681-$ | US- 6145983-$ | US- 6154552-$ | US- 6176576-$ | US- 6225897-$ | US- 6231181-$ | US-					

		6236969-$ | US-6243578-$ | US-6259367-$ | US-6270466-$ | US-6292213-$).DID.					
L1073	369	(US-6060321-$ | US-6061580-$ | US-6091832-$ | US-6115177-$ | US-6132681-$ | US-6154552-$ | US-6176576-$ | US-61810704-$ | US-6199550-$ | US-62023804-$ | US-6225897-$ | US-6231181-$ | US-6236969-$ | US-6259367-$ | US-6270466-$ | US-6292213-$ | US-6292685-$ | US-6301367-$ | US-6343858-$ | US-6409335-$ | US-6409338-$ | US-6431705-$ | US-6474816-$ | US-64782605-$ | US-64783605-$ | US-6511175-$ | US-6513532-$ | US-6517203-$ | US-6539336-$ | US-6542081-$ | US-6546101-$ | US-6554444-$ | US-6582075-$ | US-6619799-$ | US-6629076-$ | US-6686843-$ | US-6729726-$ | US-6736759-$ | US-6764194-$ | US-6769767-$ | US-6788309-$ | US-6792401-$ | US-6798391-$ | US-6824265-$ | US-6840908-$ | US-6853303-$ | US-6857741-$ | US-6871951-$ | US-6879930-$ | US-6898550-$ | US-6899585-$ | US-6912386-$ | US-6932090-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:05 AM

		6947219-$ | US- 6974226-$ | US- 7013009-$ | US- 7023594-$ | US- 7030902-$ | US- 7031667-$ | US- 7033025-$ | US- 7044615-$ | US- 7048370-$ | US- 7059717-$ | US- 7079876-$ | US- 7148879-$ | US- 7150526-$ | US- 7192136-$ | US- 7255437-$ | US- 7265358-$ | US- 7274292-$ | US- 7278734-$ | US- 7289767-$ | US- 7312699-$ | US- 7313246-$ | US- 7319780-$ | US- 7376238-$ | US- 7380936-$ | US- 7405801-$ | US- 7438409-$ | US- 7438410-$ | US- 7452067-$ | US- 7500746-$ | US- 7500747-$ | US- 7512414-$ | US- 7521623-$ | US- 7543934-$ | US- 7543938-$ | US- 7547101-$ | US- 7581833-$ | US- 7604348-$ | US- 7643895-$ | US- 7648236-$ | US- 7677723-$ | US- 7740353-$ | US- 7760898-$ | US- 7792552-$ | US- 7798638-$ | US- 7806525-$ | US- 7818142-$ | US- 7834759-$ | US- 7922321-$ | US- 8073984-$ | US- 8095799-$ | US- 8109629-$ | US- 8142015-$ | US- 8182267-$ | US- 8184067-$ | US- 8243973-$ | US- 8328420-$ | US- 8337013-$ | US- 8421851-$ | US-					

		8430507-$ | US- 8465151-$ | US- 8482488-$ | US- 8485661-$ | US- 8508851-$ | US- 8558759-$ | US- 8593795-$ | US- 8668334-$ | US- 8766747-$ | US- 8767306-$ | US- 8778022-$ | US- 8801174-$ | US- 8823740-$ | US- 8832233-$ | US- 8838708-$ | US- 8884845-$ | US- 8905541-$ | US- 8907867-$ | US- 8908894-$ | US- 8931896-$ | US- 8941560-$ | US- 8944590-$ | US- 8952869-$ | US- 8957835-$ | US- 8979259-$ | US- 9024843-$ | US- 9081212-$ | US- 9091851-$ | US- 9097890-$ | US- 9097891-$ | US- 9116545-$ | US- 9128281-$ | US- 9128522-$ | US- 9129295-$ | US- 9134534-$ | US- 9137309-$ | US- 9141194-$ | US- 9143848-$ | US- 9158116-$ | US- 9182596-$ | US- 9201512-$ | US- 9223134-$ | US- 9229227-$ | US- 9230501-$ | US- 9256071-$ | US- 9277334-$ | US- 9285589-$ | US- 9298007-$ | US- 9299194-$ | US- 9341843-$ | US- 9349280-$ | US- 9366862-$ | US- 9400390-$ | US- 9401540-$ | US- 9405135-$ | US- 9405892-$ | US- 9423842-$ | US- 9423870-$ | US-					

		9494800-$ | US- 9529197-$ | US- 9529199-$ | US- 9568746-$ | US- 9582071-$ | US- 9589482-$ | US- 9594433-$ | US- 9600079-$ | US- 9651787-$ | US- 9672210-$ | US- 9684172-$ | US- 9684374-$ | US- 9690121-$ | US- 9715112-$ | US- 9715774-$ | US- 9730647-$ | US- 9740280-$ | US- 9753288-$ | US- 9759917-$ | US- 9766463-$ | US- 9781408-$ | US- 9800990-$ | US- 9829707-$ | US- 9836122-$ | US- 9841599-$ | US- 9857590-$).DID.					
L1074	355	(US-0000733-$ | US- 0001827-$ | US- 0003803-$ | US- 0005230-$ | US- 0017997-$ | US- 0018274-$ | US- 0021407-$ | US- 0022690-$ | US- 0023158-$ | US- 0028309-$ | US- 0029582-$ | US- 0030442-$ | US- 0032449-$ | US- 0033061-$ | US- 0034478-$ | US- 0035830-$ | US- 0046887-$ | US- 0050668-$ | US- 0050754-$ | US- 0055888-$ | US- 0059159-$ | US- 0059212-$ | US- 0061579-$ | US- 0062046-$ | US- 0062338-$ | US- 0063378-$ | US- 0065257-$ | US- 0067580-$ | US- 0067585-$ | US- 0068057-$ | US- 0068117-$ | US- 0068559-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:05 AM

		0072828-$ | US- 0073375-$ | US- 0074721-$ | US- 0078274-$ | US- 0079356-$ | US- 0081982-$ | US- 0083591-$ | US- 0084990-$ | US- 0085245-$ | US- 0088365-$ | US- 0089639-$ | US- 0090103-$ | US- 0096078-$ | US- 0098192-$ | US- 0098877-$ | US- 0100384-$ | US- 0101568-$ | US- 0102734-$ | US- 0107822-$ | US- 0109491-$ | US- 0109600-$ | US- 0110368-$ | US- 0128737-$ | US- 0131575-$ | US- 0132382-$ | US- 0132913-$ | US- 0133885-$ | US- 0140899-$ | US- 0141233-$ | US- 0144854-$ | US- 0146829-$ | US- 0147215-$ | US- 0150986-$ | US- 0151175-$ | US- 0151179-$ | US- 0156012-$ | US- 0156128-$ | US- 0157649-$ | US- 0158506-$ | US- 0159023-$ | US- 0160571-$ | US- 0160572-$ | US- 0160573-$ | US- 0164122-$ | US- 0176902-$ | US- 0186330-$ | US- 0187990-$ | US- 0197002-$ | US- 0197961-$ | US- 0198293-$ | US- 0200927-$ | US- 0201440-$ | US- 0201585-$ | US- 0208531-$ | US- 0213026-$ | US- 0214630-$ | US- 0218684-$ | US- 0226978-$ | US-					

		0227219-$ | US- 0230596-$ | US- 0230988-$ | US- 0238194-$ | US- 0239502-$ | US- 0241976-$ | US- 0245754-$ | US- 0246075-$ | US- 0248717-$ | US- 0248718-$ | US- 0248719-$ | US- 0251661-$ | US- 0253590-$ | US- 0262392-$ | US- 0264752-$ | US- 0268008-$ | US- 0268013-$ | US- 0268017-$ | US- 0270663-$ | US- 0271065-$ | US- 0271116-$ | US- 0271387-$ | US- 0273365-$ | US- 0278678-$ | US- 0279584-$ | US- 0296044-$ | US- 0296045-$ | US- 0302992-$ | US- 0308089-$ | US- 0309426-$ | US- 0361185-$ | US- 1255265-$ | US- 1917745-$ | US- 20010005230-$ | US- 20010028309-$ | US- 20010050754-$ | US- 20020017997-$ | US- 20020021407-$ | US- 20020081982-$ | US- 20020084990-$ | US- 20020089639-$ | US- 20020090103-$ | US- 20020098877-$ | US- 20020101568-$ | US- 20020109600-$ | US- 20020140899-$ | US- 20020159023-$ | US- 20020197961-$ | US- 20030018274-$ | US- 20030022690-$ | US- 20030032449-$ | US- 20030062046-$ | US- 20030065257-$ | US- 20030067585-$ | US- 20030068057-$ | US- 20030083591-$ | US- 20030214630-$ | US- 20030226978-$ | US-					

		20040000733-$ | US-20040029582-$ | US-20040059212-$ | US-20040063378-$ | US-20040096078-$ | US-20040100384-$ | US-20040128737-$ | US-20040150986-$ | US-20040156012-$ | US-20040157649-$ | US-20040160571-$ | US-20040160572-$ | US-20040160573-$ | US-20040197002-$ | US-20040227219-$ | US-20050067580-$ | US-20050078274-$ | US-20050088365-$ | US-20050201585-$ | US-20050213026-$ | US-20050230596-$ | US-20050238194-$ | US-20050239502-$ | US-20050248717-$ | US-20050248718-$ | US-20050248719-$ | US-20050264752-$ | US-20060001827-$ | US-20060003803-$ | US-20060023158-$ | US-20060034478-$ | US-20060107822-$).DID.					
L1075	78	(US-10359459-$ | US-10624790-$ | US-10777048-$ | US-20030231293-$ | US-20040059212-$ | US-20040101178-$ | US-20060034478-$ | US-20070035830-$ | US-20080100792-$ | US-20090073375-$ | US-20090141233-$ | US-20120033061-$ | US-20130072828-$ | US-20130148519-$ | US-20140132913-$ | US-20160302992-$ | US-20170074721-$ | US-20170090219-$ | US-20170131575-$ | US-20170146829-$ | US-20170303187-$ | US-20190272800-$ | US-20190278110-$ | US-20190285913-$ | US-20190310132-$ | US-20190318589-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:06 AM

		20190387351-$ | US-20200012127-$ | US-20200364992-$ | US-3858001-$ | US-4904078-$ | US-5455637-$ | US-5541641-$ | US-5923398-$ | US-6091546-$ | US-6788309-$ | US-6816314-$ | US-6857741-$ | US-7023594-$ | US-7517083-$).DID.					
L1076	1066	1071 1072 1073 1074 1075	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:07 AM
L1077	63	1076 AND 927	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:07 AM
L1078	35	1076 AND 930	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/12/06 08:08 AM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1079	17	1076 AND 987	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 08:08 AM
L1080	88	"6771423"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:00 AM
L1081	124	"5671037"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:00 AM
L1082	55	"6911172"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/12/06 09:01 AM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1083	546	"6349001"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:01 AM
L1084	135	"7150526"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:01 AM
L1085	203	"7192136"	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 09:01 AM
L1086	149	"7922321"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/12/06 09:01 AM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1087	342	(US-10042186-$ | US-10045732-$ | US-10108984-$ | US-10123732-$ | US-10180572-$ | US-10215568-$ | US-10227063-$ | US-10254856-$ | US-10276028-$ | US-10310296-$ | US-10310597-$ | US-10345625-$ | US-10359459-$ | US-10448867-$ | US-10463300-$ | US-10466491-$ | US-10466510-$ | US-10469916-$ | US-10473950-$ | US-10561376-$ | US-10613355-$ | US-10617342-$ | US-10624790-$ | US-10649220-$ | US-10663740-$ | US-10678322-$ | US-10684478-$ | US-10684687-$ | US-10686972-$ | US-10690936-$ | US-10722128-$ | US-10742965-$ | US-10777048-$ | US-10824253-$ | US-10831316-$ | US-10853589-$ | US-10908421-$ | US-10997943-$ | US-11042045-$ | US-11061252-$ | US-11086147-$ | US-11115074-$ | US-11137626-$ | US-11138301-$ | US-11156856-$ | US-11204512-$ | US-1255265-$ | US-1917745-$ | US-20020021407-$ | US-20020081982-$ | US-20020090103-$ | US-20020098877-$ | US-20030022690-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:37 AM

		20030032449-$ | US- 20030226978-$ | US- 20040096078-$ | US- 20050230596-$ | US- 20050248719-$ | US- 20050278446-$ | US- 20060034478-$ | US- 20060269079-$ | US- 20070186330-$ | US- 20070258040-$ | US- 20070270663-$ | US- 20070271116-$ | US- 20080062338-$ | US- 20080144854-$ | US- 20080273166-$ | US- 20090156128-$ | US- 20090201460-$ | US- 20120002160-$ | US- 20120105740-$ | US- 20120108215-$ | US- 20120176580-$ | US- 20120194550-$ | US- 20120249797-$ | US- 20130072828-$ | US- 20130143519-$ | US- 20130169513-$ | US- 20140176902-$ | US- 20140198293-$ | US- 20150309316-$ | US- 20150309534-$ | US- 20160187651-$ | US- 20160223832-$ | US- 20160239985-$ | US- 20190278110-$ | US- 20190285913-$ | US- 20200029140-$ | US- 20220011603-$ | US- 2249572-$ | US- 2638532-$ | US- 2794085-$ | US- 2818511-$ | US- 2830132-$ | US- 2874230-$ | US- 2904670-$ | US- 3060308-$ | US- 3597054-$ | US- 3710115-$ | US- 3858001-$ | US- 3883701-$ | US- 4165487-$ | US- 4254451-$ | US- 4283127-$ | US- 4322585-$ | US- 4348664-$ | US- 4389217-$ | US- 4526473-$ | US- 4535244-$ | US- 4608492-$ | US-					

		4683587-$ | US- 4751691-$ | US- 4757714-$ | US- 4806011-$ | US- 4822160-$ | US- 4822161-$ | US- 4851666-$ | US- 4851686-$ | US- 4856086-$ | US- 4859047-$ | US- 4882769-$ | US- 4962469-$ | US- 4967268-$ | US- 4985632-$ | US- 5008548-$ | US- 5015086-$ | US- 5020150-$ | US- 5026151-$ | US- 5064410-$ | US- 5093576-$ | US- 50963103-$ | US- 5151600-$ | US- 5161250-$ | US- 5172256-$ | US- 5264877-$ | US- 52756503-$ | US- 5306917-$ | US- 5353378-$ | US- 5359444-$ | US- 5367345-$ | US- 5379464-$ | US- 5382986-$ | US- 5394005-$ | US- 5452026-$ | US- 5452480-$ | US- 5455637-$ | US- 5455640-$ | US- 5457751-$ | US- 5463428-$ | US- 5500532-$ | US- 5510961-$ | US- 5513384-$ | US- 5533130-$ | US- 5581090-$ | US- 5585871-$ | US- 56279804-$ | US- 5634201-$ | US- 5671035-$ | US- 5673692-$ | US- 5694475-$ | US- 5715323-$ | US- 58316904-$ | US- 5835185-$ | US- 5900720-$ | US- 5903395-$ | US- 59204504-$ | US- 5923398-$ | US- 5941837-$ | US-					

		5946071-$ | US- 5949516-$ | US- 5963294-$ | US- 5966746-$ | US- 5988812-$ | US- 5991085-$ | US- 5992996-$ | US- 6010216-$ | US- 6013919-$ | US- 6028627-$ | US- 6046455-$ | US- 60519104-$).DID.					
L1088	183	(US-6292685-$ | US- 6301367-$ | US- 6307526-$ | US- 6343858-$ | US- 6349001-$ | US- 6349422-$ | US- 6409335-$ | US- 6409338-$ | US- 6426719-$ | US- 6431705-$ | US- 6474816-$ | US- 6478736-$ | US- 6506142-$ | US- 6511175-$ | US- 6513532-$ | US- 6517203-$ | US- 6539336-$ | US- 6542081-$ | US- 6546101-$ | US- 6554763-$ | US- 6582075-$ | US- 6619799-$ | US- 6629076-$ | US- 6729726-$ | US- 6736759-$ | US- 6764194-$ | US- 6769767-$ | US- 6788309-$ | US- 6792401-$ | US- 6824265-$ | US- 6871951-$ | US- 6879930-$ | US- 6912386-$ | US- 6929365-$ | US- 6932090-$ | US- 6947219-$ | US- 7004582-$ | US- 7013009-$ | US- 7030902-$ | US- 7031667-$ | US- 7033025-$ | US- 7059717-$ | US- 7073905-$ | US- 7079876-$ | US- 7123215-$ | US- 7192136-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:37 AM

		7255437-$ | US- 7265358-$ | US- 7274292-$ | US- 7289767-$ | US- 7312699-$ | US- 7331666-$ | US- 7376238-$ | US- 7380936-$ | US- 7401918-$ | US- 7405801-$ | US- 7429965-$ | US- 7438409-$ | US- 7438410-$ | US- 7445332-$ | US- 7481531-$ | US- 7500746-$ | US- 7500747-$ | US- 7512414-$ | US- 7527374-$ | US- 7543934-$ | US- 7581833-$ | US- 7621634-$ | US- 7648236-$ | US- 7677723-$ | US- 7760898-$ | US- 7771046-$ | US- 7792552-$ | US- 7806525-$ | US- 7922321-$ | US- 7976159-$ | US- 8109629-$ | US- 8142015-$ | US- 8337013-$ | US- 8430507-$ | US- 8434863-$ | US- 8465151-$ | US- 8485661-$ | US- 8500271-$ | US- 8770742-$ | US- 8905542-$ | US- 9033493-$ | US- 9244292-$ | US- 9405135-$ | US- 9488520-$ | US- 9547184-$ | US- 9690121-$ | US- D369167-$).DID.				
L1089	211	(US-3192826-$ | US- 3216308-$ | US- 3229580-$ | US- 3524710-$ | US- 3610825-$ | US- 3787109-$ | US- 3885095-$ | US- 3915548-$ | US- 3923370-$ | US- 3936605-$ | US- 3940204-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/12/06 09:37 AM

		4052073-$ | US- 4082432-$ | US- 4195915-$ | US- 4218111-$ | US- 4447128-$ | US- 4550984-$ | US- 4649434-$ | US- 4664475-$ | US- 4665385-$ | US- 4722601-$ | US- 4751691-$ | US- 4753514-$ | US- 4799765-$ | US- 4806001-$ | US- 4806011-$ | US- 4818048-$ | US- 4826287-$ | US- 4852988-$ | US- 4853306-$ | US- 4867551-$ | US- 4869575-$ | US- 4884137-$ | US- 4961626-$ | US- 4968117-$ | US- 4973132-$ | US- 4973139-$ | US- 4988183-$ | US- 5003300-$ | US- 5013134-$ | US- 5028119-$ | US- 5044709-$ | US- 5050962-$ | US- 5053755-$ | US- 5129716-$ | US- 5138470-$ | US- 5162828-$ | US- 5212471-$ | US- 5214425-$ | US- 5231379-$ | US- 5281957-$ | US- 5281960-$ | US- 5309169-$ | US- 5320538-$ | US- 5325386-$ | US- 5334991-$ | US- 5348477-$ | US- 5359669-$ | US- 5367345-$ | US- 5369415-$ | US- 5381267-$ | US- 5384654-$ | US- 5392158-$ | US- 5416876-$ | US- 5446507-$ | US- 5455591-$ | US- 5459612-$ | US- 5469185-$ | US- 5491510-$ | US-	RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

		5506728-$ | US- 5519410-$ | US- 5537253-$ | US- 5539578-$ | US- 5576887-$ | US- 5579148-$ | US- 5583590-$ | US- 5585871-$ | US- 5589846-$ | US- 5596451-$ | US- 5606743-$ | US- 5610765-$ | US- 5626410-$ | US- 5629790-$ | US- 5648789-$ | US- 5653751-$ | US- 5654827-$ | US- 5654828-$ | US- 5671037-$ | US- 5673139-$ | US- 5682173-$ | US- 5699194-$ | US- 5712649-$ | US- 5717479-$ | US- 5719588-$ | US- 5744788-$ | US- 5751493-$ | US- 5808589-$ | US- 5815326-$ | US- 5886822-$ | US- 5943171-$ | US- 5973845-$ | US- 5991103-$ | US- 6005720-$ | US- 6023372-$ | US- 6081304-$ | US- 6091546-$ | US- D195365-$ | US- RE28847-$).DID.					
L1090	156	(US-20020098877-$ | US-20020118825-$ | US-20020176330-$ | US-20030003969-$ | US-20030022690-$ | US-20030067585-$ | US-20030068057-$ | US-20040000733-$ | US-20040132509-$ | US-20040156012-$ | US-20040157649-$ | US-20040160572-$ | US-20040160573-$ | US-20040239874-$ | US-20050046789-$ | US-20050046790-$ | US-20050128431-$ | US-20050185815-$ | US-20060183427-$ |	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:37 AM

		US-2424935-$ | US- 2856466-$ | US- 2882348-$ | US- 2999136-$ | US- 3104290-$ | US- 3119903-$ | US- 3495898-$ | US- 3588384-$ | US- 3665122-$ | US- 3769663-$ | US- 3883701-$ | US- 4636048-$ | US- 4683587-$ | US- 4856086-$ | US- 4882769-$ | US- 4902120-$ | US- 4904078-$ | US- 5020150-$ | US- 5159639-$ | US- 5327178-$ | US- 5335285-$ | US- 5367345-$ | US- 5533130-$ | US- 5579400-$ | US- 5606743-$ | US- 5608808-$ | US- 5634201-$ | US- 5694475-$ | US- 5715323-$ | US- 5717479-$ | US- 5737436-$ | US- 5781272-$ | US- 5892564-$ | US- 5988812-$ | US- 6010216-$ | US- 6012812-$ | US- 6176576-$ | US- 6218958-$ | US- 6233344-$ | US- 6233345-$ | US- 6252970-$ | US- 6301050-$ | US- 6301367-$ | US- 6311155-$ | US- 6325507-$ | US- 6349001-$ | US- 6356392-$ | US- 6384982-$ | US- 6392798-$ | US- 6409338-$ | US- 6421031-$ | US- 6456721-$ | US- 6490362-$ | US- 6690807-$ | US- 6729726-$ | US- 6769767-$ | US- 6929365-$ | US- 6966647-$ | US-					

		7004582-$ | US-7013009-$ | US-D207919-$ | US-D212863-$ | US-D418153-$ | US-D426845-$ | US-D435058-$ | US-D445416-$ | US-D462708-$ | US-RE35051-$).DID.					
L1091	93	(US-20010035242-$ | US-20020072387-$ | US-20020193151-$ | US-20030036414-$ | US-20030040285-$ | US-20030042348-$ | US-20030108217-$ | US-20030182003-$ | US-20040077382-$ | US-20040204165-$ | US-20050078274-$ | US-20050128431-$ | US-20050201585-$ | US-20050220316-$ | US-20050248717-$ | US-20050255883-$ | US-20050255898-$ | US-20060013410-$ | US-20060023158-$ | US-20060093178-$ | US-20060153409-$ | US-20060177086-$ | US-20060185062-$ | US-20060251283-$ | US-20070064969-$ | US-20090175482-$ | US-2249572-$ | US-3528734-$ | US-4456797-$ | US-4902120-$ | US-4942617-$ | US-5034995-$ | US-5164987-$ | US-5422957-$ | US-5608808-$ | US-5715323-$ | US-5737436-$ | US-5881160-$ | US-6095820-$ | US-6097822-$ | US-6176576-$ | US-6633770-$ | US-6643528-$ | US-6690808-$ | US-6920228-$ | US-7519192-$ | US-7702122-$ | US-D533539-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:37 AM

L1092	907	1087 1088 1089 1090 1091	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 09:38 AM
L1093	37	1092 AND 927	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:00 AM
L1094	19	1092 AND 930	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:00 AM
L1095	12	1092 AND 987	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/12/06 10:00 AM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1096	64	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND temple AND ((speaker$2 OR audio) SAME (sound WITH guid$4)) AND (hear$4 WITH impair$5)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:12 AM
L1097	657	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND (hear$4 WITH impair$5)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:12 AM
L1098	99	(eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND (circuit near10 board) AND (electric$4 WITH control$4) AND (memor$4 OR stor$4) AND (batter$4 near10 rechargeable) AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:13 AM

		AND second AND bridge AND partial$4 AND (hear$4 WITH impair$5)					
L1099	12	"2005167902"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:24 AM
L1100	2	"20050278446"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:24 AM
L1101	10	"20200012127"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:24 AM
L1102	5	"20170090219"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2022/12/06 10:25 AM

			EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L1103	16	(US-11042045-$ | US-11086147-$ | US-20050278446-$ | US-20070248238-$ | US-20080211921-$ | US-20120062357-$ | US-20210271116-$ | US-9922236-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:35 AM
L1104	20	(US-11086147-$ | US-11204512-$ | US-20050278446-$ | US-20080211921-$ | US-20120062357-$ | US-20190033622-$ | US-20210271116-$ | US-20210364827-$ | US-20210364828-$ | US-9922236-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:35 AM
L1105	40	(US-7976159-$ | US-8109629-$ | US-8142015-$ | US-8174569-$ | US-8337013-$ | US-8430507-$ | US-8434863-$ | US-8465151-$ | US-8485661-$ | US-8500271-$ | US-8770742-$ | US-8905542-$ | US-9033493-$ | US-9244292-$ | US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	OR	ON	ON	2022/12/06 10:35 AM

		9400390-$ | US-9405135-$ | US-9488520-$ | US-9547184-$ | US-9690121-$).DID.	JPO; DERWENT; IBM_TDB)				
L1106	65	(US-7517083-$ | US-7527374-$ | US-7543934-$ | US-7581833-$ | US-7621634-$ | US-7648236-$ | US-7677723-$ | US-7760898-$ | US-7771046-$ | US-7792552-$ | US-7806525-$ | US-7922321-$ | US-7976159-$ | US-8109629-$ | US-8142015-$ | US-8174569-$ | US-8337013-$ | US-8430507-$ | US-8434863-$ | US-8465151-$ | US-8485661-$ | US-8500271-$ | US-8770742-$ | US-8905542-$ | US-9033493-$ | US-9244292-$ | US-9400390-$ | US-9405135-$ | US-9488520-$ | US-9547184-$ | US-9690121-$ | US-D369167-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:35 AM
L1107	40	(US-0011603-$ | US-0054092-$ | US-0104864-$ | US-0172691-$ | US-0226838-$ | US-0369402-$ | US-11243416-$ | US-20040104864-$ | US-20130172691-$ | US-20140226838-$ | US-20190369402-$ | US-20220011603-$ | US-20220054092-$ | US-5144344-$ | US-5475798-$ | US-5777715-$ | US-6301050-$ | US-6346929-$ | US-6717737-$ | US-6771423-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:35 AM

L1108	13	(US-9880441-$ | US-9882992-$ | US-9910298-$ | US-9922236-$ | US-9939934-$ | US-9952883-$ | US-9965681-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:35 AM
L1109	139	1103 1104 1105 1106 1107 1108	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:37 AM
L1110	24	1109 AND 927	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/12/06 10:37 AM
L1111	13	1109 AND 930	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/12/06 10:37 AM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N129	13155	(((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N130	123	(((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N131	109	(((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4)	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N132	105	(((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM

		("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND (communicat$4 near10 wireless$4) AND (audio OR speak$4) AND embed$4					
N133	84	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N134	65	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM

		embed$4 AND microphone AND left AND right AND first AND second AND bridge					
N135	65	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N136	61	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N137	56	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM

		("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4 AND (ear WITH buds)					
N138	56	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV. AND (eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4 AND (ear near5 buds)	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 03:07 PM
N152	37	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 04:56 PM
N153	25	((eyewear$4 OR glasses$4 OR spetacl$4 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 04:56 PM

		eyegalss$4) AND (temple SAME (speakers WITH audio))).clm.					
N154	11	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 04:56 PM
N155	7	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 05:38 PM
N156	5	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 05:38 PM
N157	4	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND (communicat$4 near10 wireless$4) AND (audio OR speak$4) AND embed$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/05 05:38 PM
N158	4	((eyewear$4 OR glasses$4 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 08:09 AM

		spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone).clm.					
N159	3	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND temple AND ((speaker$2 OR audio) SAME (sound WITH guid$4))).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 08:09 AM
N160	3	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 08:09 AM
N161	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 09:13 AM
N162	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 09:13 AM

		eyegalss$4) AND frame AND (circuit near10 board) AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4).clm.					
N163	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND (circuit near10 board) AND (electric$4 WITH control$4) AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 09:13 AM
N169	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND (circuit near10 board) AND (electric$4 WITH control$4) AND (memor$4 OR stor$4) AND (batter$4 near10 rechargeable) AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 10:23 AM
N170	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 10:23 AM

		eyegalss$4) AND frame AND circuit AND control$4 AND (memor$4 OR stor$4) AND batter$4 AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND (hear$4 WITH impair$5)).clm.					
N171	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND temple AND ((speaker$2 OR audio) SAME (sound WITH guid$4)) AND (hear$4 WITH impair$5)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 10:23 AM
N172	0	((eyewear$4 OR glasses$4 OR spetacl$4 OR eyegalss$4) AND frame AND (circuit near10 board) AND (electric$4 WITH control$4) AND (memor$4 OR stor$4) AND (batter$4 near10 rechargeable) AND connect$4 AND communicat$4 AND (audio OR speak$4) AND wireless$4 AND embed$4 AND microphone AND left AND right AND first AND second AND bridge AND partial$4 AND (hear$4 WITH impair$5)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/06 10:23 AM

PE2E SEARCH - Search History (Similarity Search)

Ref #	Application Number	Text Selections	CPC Selections
L904	17/873,104	No selections	No selections
L905	17/873,104	(Abstract) Techniques for providing wearable electronic devices with electrical components are disclosed. The electrical components can provide electrical technology to eyewear to facilitate audio support including enhanced	(G02C11/10) Electronic devices other than hearing aids (G02C5/001) Constructions of non-optical parts specially adapted for particular

		hearing. The electrical components can operate independently or together with other electrical components provided elsewhere. The wearable electronic devices with electronic components can, for example, provide audio output, audio enhancements, or event-related audio content.	purposes, not otherwise provided for or not fully classifiable according to technical characteristics, e.g. therapeutic glasses (G02C5/14) Side-members (G02C11/06) Hearing aids
L906	17/873,104	(Claims) A personal audio system operable to at least generate customized audio output, comprising: a pair of ear buds, each configured to be placed in an ear of a user; a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the mobile communication device producing audio output signals customized for the user based on at least the stored hearing profile associated with the user, and the mobile communication device configure to transmit the customized audio output signals to the pair of ear buds, wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.	(G02C11/10) Electronic devices other than hearing aids (G02C5/001) Constructions of non-optical parts specially adapted for particular purposes, not otherwise provided for or not fully classifiable according to technical characteristics, e.g. therapeutic glasses (G02C5/14) Side-members (G02C11/06) Hearing aids
L1046	17/873,104	(Abstract) Techniques for providing wearable electronic devices with electrical components are disclosed. The electrical components can provide electrical technology to eyewear to facilitate audio support including enhanced hearing. The electrical components can operate independently or together with other electrical components provided elsewhere. The wearable electronic devices with electronic components can, for example, provide audio output, audio enhancements, or event-related audio content. (Claims) A personal audio system operable to at least generate customized audio output, comprising: a pair of ear buds, each configured to be placed in an ear of a user; a mobile communication device at least for supporting audio output, the mobile	No selections

		communication device configured to store at least a hearing profile associated with the user, the mobile communication device producing audio output signals customized for the user based on at least the stored hearing profile associated with the user, and the mobile communication device configure to transmit the customized audio output signals to the pair of ear buds, wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.	
L1047	17/873,104	(Abstract) Techniques for providing wearable electronic devices with electrical components are disclosed. The electrical components can provide electrical technology to eyewear to facilitate audio support including enhanced hearing. The electrical components can operate independently or together with other electrical components provided elsewhere. The wearable electronic devices with electronic components can, for example, provide audio output, audio enhancements, or event-related audio content. (Claims) A personal audio system operable to at least generate customized audio output, comprising: a pair of ear buds, each configured to be placed in an ear of a user; a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the mobile communication device producing audio output signals customized for the user based on at least the stored hearing profile associated with the user, and the mobile communication device configure to transmit the customized audio output signals to the pair of ear buds, wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at	(G02C11/06) Hearing aids (G02C5/143) Side-members having special ear pieces

		least the portion of the customized audio output signals being received.	
L1048	17/873,104	(Abstract) Techniques for providing wearable electronic devices with electrical components are disclosed. The electrical components can provide electrical technology to eyewear to facilitate audio support including enhanced hearing. The electrical components can operate independently or together with other electrical components provided elsewhere. The wearable electronic devices with electronic components can, for example, provide audio output, audio enhancements, or event-related audio content. (Claims) A personal audio system operable to at least generate customized audio output, comprising: a pair of ear buds, each configured to be placed in an ear of a user; a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the mobile communication device producing audio output signals customized for the user based on at least the stored hearing profile associated with the user, and the mobile communication device configure to transmit the customized audio output signals to the pair of ear buds, wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.	(G02C11/06) Hearing aids (G02C5/143) Side-members having special ear pieces (G02C5/14) Side-members (G02C5/001) Constructions of non-optical parts specially adapted for particular purposes, not otherwise provided for or not fully classifiable according to technical characteristics, e.g. therapeutic glasses (G02C11/10) Electronic devices other than hearing aids
L1049	17/873,104	(Claims) A personal audio system operable to at least generate customized audio output, comprising: a pair of ear buds, each configured to be placed in an ear of a user; a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the mobile communication device producing audio output signals customized for the user based on at least the stored hearing	(G02C11/06) Hearing aids (G02C5/143) Side-members having special ear pieces (G02C5/14) Side-members (G02C5/001) Constructions of non-optical parts specially adapted for particular purposes, not otherwise provided for or not fully classifiable according to technical characteristics, e.g. therapeutic glasses (G02C11/10) Electronic devices other than

		profile associated with the user, and the mobile communication device configure to transmit the customized audio output signals to the pair of ear buds, wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.	hearing aids
L1050	17/873,104	(Abstract) Techniques for providing wearable electronic devices with electrical components are disclosed. The electrical components can provide electrical technology to eyewear to facilitate audio support including enhanced hearing. The electrical components can operate independently or together with other electrical components provided elsewhere. The wearable electronic devices with electronic components can, for example, provide audio output, audio enhancements, or event-related audio content. (Claims) A personal audio system operable to at least generate customized audio output, comprising: a pair of ear buds, each configured to be placed in an ear of a user; a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the mobile communication device producing audio output signals customized for the user based on at least the stored hearing profile associated with the user, and the mobile communication device configure to transmit the customized audio output signals to the pair of ear buds, wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received. (Specification) the invention pertains to	(G02C11/06) Hearing aids (G02C5/143) Side-members having special ear pieces (G02C5/14) Side-members (G02C5/001) Constructions of non-optical parts specially adapted for particular purposes, not otherwise provided for or not fully classifiable according to technical characteristics, e.g. therapeutic glasses (G02C11/10) Electronic devices other than hearing aids

		techniques for providing wearable electronic devices (e.g., head-worn electronic devices, such as eyewear) with electrical components are disclosed. The electrical components can provide electrical technology to eyewear to facilitate audio support including enhanced hearing. The electrical components can operate independently or together with other electrical components provided elsewhere. The wearable electronic devices with electronic components can, for example, provide audio output, audio enhancements, or event-related audio content.	

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: HOWELL et al.	Attorney Docket No.: IPVCP003C10
Application No.: 17/873,104	Examiner: LEI, JIE
Filed: July 25, 2022	Group: 2872
Title: WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT	

AMENDMENT B

Mail Stop _____
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action dated November 4, 2022, please amend the above-identified patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 4 of this paper.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/873,104	Filing Date 07/25/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/06/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 76	Minus	** 20	= 56		x $100 =	5600
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	5600

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/RENEE D HAWKINS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	17873104	Filing Date	2022-07-25	Docket Number (if applicable)	IPVCP003C10	Art Unit	2872
First Named Inventor	HOWELL et al.			Examiner Name	JIE, LEI		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 503874

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/C. Douglass Thomas/	Date (YYYY-MM-DD)	2023-03-06
Name	C. Douglass Thomas	Registration Number	32947

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: HOWELL et al.	Attorney Docket No.: IPVCP003C10
Application No.: 17/873,104	Examiner: JIE, LEI
Filed: July 25, 2022	Group: 2872
Title: WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT	

INFORMATION DISCLOSURE STATEMENT
37 CFR §§1.56 AND 1.97(b)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The references listed in the attached PTO Form 1449, copies of which are attached, may be material to examination of the above-identified patent application. Applicants submit these references in compliance with their duty of disclosure pursuant to 37 CFR §§1.56 and 1.97. The Examiner is requested to make these references of official record in this application.

This Information Disclosure Statement is not to be construed as a representation that a search has been made, that additional information material to the examination of this application does not exist, or that these references indeed constitute prior art.

This Information Disclosure Statement is: (i) filed within three (3) months of the filing date of the above-referenced application, (ii) believed to be filed before the mailing date of a first Office Action on the merits, or (iii) believed to be filed before the mailing of a first Office Action after the filing of a Request for Continued Examination under §1.114.

Apple Inc. Exhibit 1002 Page 998

Accordingly, it is believed that no fees are due in connection with the filing of this Information Disclosure Statement. However, if it is determined that any fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-3874 (Order No. IPVCP003C10).

Respectfully submitted,

/C. Douglass Thomas/

C. Douglass Thomas
Registration No. 32,947

4010 Moorpark Avenue
Suite 211
San Jose, CA 95117

Apple Inc. Exhibit 1002 Page 999

Form 1449 (Modified)	Atty. Docket No.	IPVCP003C10
	Application No.:	17/873,104
Information Disclosure Statement By Applicant	Applicant	HOWELL et al.
	Filing Date	July 25, 2022
	Group	2872
(Use Several Sheets if Necessary)		Page 1 of 3

U.S. Patent Documents

Examiner Initial	No.	Patent No.	Date	Patentee	Class	Sub-class	Filing Date
	1.	2002/0136414 A1	Sep-02	Jordan et al.			
	2.	2003/0064746 A1	Apr-03	Rader et al.			
	3.	2003/0091200 A1	May-03	Pompei			
	4.	2004/0005069 A1	Jan-04	Buck			
	5.	2004/0114770 A1	Jun-04	Pompei			
	6.	2005/0036103 A1	Feb-05	Bloch			
	7.	2006/0291667 A1	Dec-06	Watanabe et al.			
	8.	2007/0189548 A1	Aug-07	Croft III			
	9.	2007/0211574 A1	Sep-07	Croft III			
	10.	2008/0089545 A1	Apr-08	Jannard et al.			
	11.	2010/0045928 A1	Feb-10	Levy			
	12.	2010/0105445 A1	Apr-10	BRUNTON et al.			
	13.	2012/0101411 A1	Apr-12	Hausdorff et al.			
	14.	2015/0277123 A1	Oct-15	CHAUM et al.			
	15.	2015/0338677 A1	Nov-15	Block			
	16.	2016/0098874 A1	Apr-16	Handville et al.			
	17.	2018/0122208 A1	May-18	Peyrard			
	18.	2019/0004325 A1	Jan-19	Connor			
	19.	2019/0378493 A1	Dec-19	KIM et al.			
	20.	2021/0000347 A1	Jan-21	Stump			
	21.	2021/0026146 A1	Jan-21	Harder et al.			
	22.	2021/0379425 A1	Dec-21	Tran			
	23.	2022/0008763 A1	Jan-22	SALEH et al.			
	24.	2022/0034542 A1	Feb-22	Peters et al.			
	25.	2022/0178743 A1	Jun-22	Howell et al.			
	26.	2022/0335792 A1	Oct-22	Howell et al.			
	27.	2022/0415388 A1	Dec-22	Cheung et al.			
	28.	2023/0017634 A1	Jan-23	Howell et al.			

Examiner	Date Considered

Examiner: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Form 1449 (Modified)	Atty. Docket No.	IPVCP003C10
	Application No.:	17/873,104
Information Disclosure Statement By Applicant	Applicant	HOWELL et al.
	Filing Date	July 25, 2022
	Group	2872
(Use Several Sheets if Necessary)		Page 2 of 3

	29.	2023/0033660 A1	Feb-23	Howell et al.				
	30.	2023/0057654 A1	Feb-23	Howell et al.				
	31.	3,104,290	Sep-63	Rosemond et al.				
	32.	3,119,903	Jan-64	Rosemond et al.				
	33.	4,904,078	Feb-90	Gorike				
	34.	5,519,781	May-96	Kukurudza				
	35.	5,819,183	Oct-98	Voroba et al.				
	36.	6,231,181 B1	May-01	Swab				
	37.	6,311,155 B1	Oct-01	Vaudrey et al.				
	38.	6,582,075 B1	Jun-03	Swab et al.				
	39.	6,678,381 B1	Jan-04	Manabe				
	40.	7,013,009 B2	Mar-06	Warren				
	41.	7,801,570 B2	Sep-10	Cheung et al.				
	42.	8,849,185 B2	Sep-14	Cheung et al.				
	43.	10,515,623 B1	Dec-19	Grizzel				
	44.	10,802,582 B1	Oct-20	Clements				
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Examiner	Date Considered

Examiner: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Form 1449 (Modified) **Information Disclosure Statement By Applicant** (Use Several Sheets if Necessary)	Atty. Docket No.	IPVCP003C10
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	Applicant	HOWELL et al.
	Filing Date	July 25, 2022
	Group	2872
		Page 3 of 3

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(54) **LIGHT WEIGHT, COMPACT REMOUNTABLE ELECTRONIC DISPLAY DEVICE FOR EYEGLASSES OR OTHER HEAD-BORNE EYEWEAR FRAMES**

LEICHTGEWICHTE, KOMPAKTE, WIEDERBEFESTIGBARE ELEKTRONISCHE ANZEIGEVORRICHTUNGFÜR BRILLENGLÄSER ODER ANDEREN AM KOPF GETRAGENEN BRILLENSTELLEN

DISPOSITIF D'AFFICHAGE ELECTRONIQUE LEGER, COMPACT, AMOVIBLE POUR VERRES DE LUNETTES OU AUTRES MONTURES DE LUNETTES PORTEES EN CASQUE

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Description

BACKGROUND OF THE INVENTION

[0001] There are many examples of displays mounted on the head, sunglasses, eyeglasses and the like. For example, Perera in U.S. Patent 4,867,551 describes a display to be mounted on eyeglasses, the limitation of which is the high degree of occlusion of the user's field of view beyond the display, and the use of non-axial optics which introduces distortion. A high degree of occlusion is also present in an eyeglass mounted display offered for sale by Albacomp Computers Corp. Other companies, such as Liquid Image or Virtual Vision, provide displays that are suspended by a cable, gooseneck fixture or other mechanical support in front of one or both of the user's eyes. Similarly, displays from Reflection Technology have been mounted on eyewear in order to provide a computer display in a mobile fashion. This approach also highly limits the user's view of the surroundings.

[0002] Not only do such prior art displays obscure a large part of the user's visual field, but also the display obscures the user's face. The obscuration of the visual field is a limitation particularly in applications in which the user must be free to focus on the work at hand, without diverting attention to the display.

[0003] Generally, head-mounted and helmet-mounted display systems are based on miniature displays having a diagonal dimension of 4 cm or less. The display systems that use such miniature displays must provide a lens near the eye for magnification, and to make possible comfortable viewing at near distances. The lens and any other associated optics that must be placed near the eye are termed the "eyepiece." Most prior art head-mounted systems also place the display (for example a miniature liquid crystal flat panel display) near the eye as well, which requires both a support fixture for the eyepiece, and a conduit for electrical cables to the display. These components (wires, liquid crystal display, and any other required circuits) are placed within an opaque housing near the eye. Consequently, such systems block a portion of the user's visual field, and also obscure the user's face. Obscuration of the face reduces the desirability of using the device in social occasions.

[0004] A helmet-mounted display is also known in which the image is provided by a glass fixture suspended in front of the user's face. The glass fixture is mounted to the helmet and contains an eyepiece near the eye. The glass fixture serves as a mechanical support for the eyepiece as well as an image conduit for the display which is mounted to the helmet. The limitation of this system, however, is its size and weight, and its configuration as a helmet.

[0005] US 5,369,415 discloses a display which writes an image directly on the retina of an eye. The display includes a laser which produces a collimated light beam that is modulated with video information and is then scanned and directed through the eye pupil to produce an image on the retina. The scanning uses micro-machined mirrors, electro-optic or acousto-optic devices which are extremely small and require very low power.

SUMMARY OF THE INVENTION

[0006] The present invention, defined in the appended claims, provides a compact, remountable display device for attachment to eyewear having a head-borne frame. The display devices are provided as defined by the independent claims.

[0007] This invention provides a new approach to a light weight, compact, ergonomic, remountable display system that combines an image relay system and mechanical support with a simple mounting system that can be applied to eyeglasses or other head gear. The display device provides several improvements on the prior art, including the use of a miniature flat panel display mounted near the glasses combined with a transparent optomechanical fixture that suspends the eyepiece near the eye. The display device can be mounted to eyeglasses or other head gear, does not significantly obscure the field of view of the user, does not hide the user's face, and provides a largely undistorted image of the displayed image as well as of the ambient scene. Similarly, the view of the user's eye to another observer is largely undistorted as well. The display device is able to provide an image in a see-through manner, so that the user sees a superposition of the image from the display and the ambient image.

[0008] This invention provides many of the same functions and advantages as the image combining system described in Patent Application No. 08/844,098, filed on April 18, 1997, entitled "Image Combining System for Eyeglasses and Face Mask. The invention has the additional advantage that it can be fit to a wide range of users without prescriptive correction or other customization.

[0009] The display device can be made adjustable to allow the user to position the image in a convenient location in the user's field of view. The device can be added to or removed from eye glasses with little discomfort to the user. The device may include a clamping mechanism to attach to the temple of a pair of eyeglass frames. In an alternative example, the device may clip to a lower or upper edge of the frame around the lens. The device may also include a hinge or link element to allow the optical element to be moved away from the user's field of view without removing the device from the eyeglass frames. Two display devices may also be used to provide a binocular display.

DESCRIPTION OF THE DRAWINGS

[0010] The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

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Fig. 1 is a plan view of a display device mounted to a pair of eyeglass frames;
Fig. 2 is a plan view of the display device of Fig. 1;
Fig. 3 is a plan view of an imaging assembly and optical element of the display device of Fig. 1;
Fig. 4 is an exploded view of a housing assembly of the display device of Fig. 1;
Fig. 5 is a cross-sectional view of the housing assembly of Fig. 4;
Fig. 6 is a cross-sectional view of the display device of Fig. 1;
Fig. 6A is a cross-sectional view taken along line 6-6 of Fig. 6;
Fig. 7 is a plan view of a further example of a display device using a swivel fixture;
Fig. 8 is a plan view of the display device of Fig. 7;
Fig. 9 is a plan view of an embodiment of an optical element;
Fig. 10 is a plan view of a further example of the display device using a graded index lens;
Fig. 11 is a plan view of a still further example of the display device illustrating an alternative optical path and optical element;
Fig. 12 is a plan view of a further example of the display device using a link element;
Fig. 13 is a plan view of the display device of Fig. 12;
Fig. 14 is a side view of a further example of the display device using a mounting along the outer bottom edge of an eyeglass frame; and
Fig. 15 is a plan view of a further example having a rotatable adjustment mechanism.

DETAILED DESCRIPTION OF THE INVENTION

[0011] A display device is illustrated generally in Fig. 1. The display device 10 comprises an imaging assembly 12 (see Figs. 4-6), an optical element 14, and a housing assembly 16 which is removably mountable to eyeglass frames 18.

[0012] Referring to Figs. 1-6, the housing assembly 16 includes an enclosure 20 for containing circuitry 22 for receiving data or images relayed to the display device 10 and for containing the imaging assembly. The circuitry may include integrated or discrete circuits which are connected to the imaging assembly. Light from the imaging assembly is relayed via the optical element 14 through the eyeglass lens 24 to the user's eye. The optical element 14 comprises a transparent fixture or relay 26 and an eyepiece assembly 28 which, in the example shown in Figs. 1 through 3, comprises a mirror 30 and lens 32. The housing assembly 16 is mounted to the temple 34 of the user's glasses 18 by a clamping assembly 36 illustrated by a mounting fixture 38 and clamps 40. The relay 26 and eyepiece assembly 28 are positioned in front of the user's eyeglass lens 24 so that the image is viewed through the eye lens 32 which is positioned by the user in a convenient location for viewing. The housing assembly is located substantially outside the user's field of view, which means that the housing assembly does not block the user's main field of view. For corrective lenses, the main field of view is defined by the view through the lens. For non-corrective lenses such as safety glasses, the main field of view is defined by the area bounded by about 45° to the sides of a line looking ahead and about 20° above and below the line the looking ahead.

[0013] The imaging assembly 12 may comprise a transmissive or reflective miniature active matrix liquid crystal display (AMLCD), an electroluminescent display, or any other miniature flat panel display having a screen diagonal of less than 2 cm. For example, the Kopin Cyber Display P/N KCD-QMO2-AA is suitable. Additionally, the imaging component may comprise a scanning display as described in U.S. Patent No. 5,715,337 or any number of other imaging elements formed from liquid crystals, light emitting diodes, electroluminescent materials or field emissions displays. In Figs. 4 through 6, an AMLCD image generator 40 with a backlight 42 is shown. The backlight may be made from any number of illuminators such as light emitting diodes, incandescent lamps, lasers, or other light emitting devices. For a reflective AMLCD, the backlight is repositioned as a front light by methods known in the art.

[0014] The optical element 14 preferably comprises five optical surfaces 44, 46, 48, 49, and 50 (Fig. 6). The optical element 14 is preferably rectangular in cross section, as shown in Fig. 6A. The surfaces 52 and 53 may optionally also be of optical quality, or may be frosted or blackened, and may or may not be optically parallel. Preferably, sections of the optical relay 26 within the user's main field of view are optically clear and of uniform index of refraction. The surfaces 49 and 50 are polished and optically parallel so that ray 54 representing a ray from the ambient scene traverses the relay with little or no change in propagation angle.

[0015] Surface 44, which may optionally be formed by a lens 45, receives rays created by the imaging assembly. The rays propagate through the relay 26 to the surface 46, which comprises a mirror 30 in the example illustrated in Figs. 1 through 6. The sides of the relay 26 are preferably parallel to minimize refraction and thus displacement in the image. The mirror 30 reflects the light toward the surface 48 of the lens 32. The lens 32 modifies the vergence of the rays from the imaging assembly 12 so that the image can be viewed with magnification and with the image formed at a comfortable distance between about 25 cm and infinity, depending on lens positions and focal lengths. The typical focal lengths of the lenses 45 and 32 are in the range of 20 to 100 mm. The lens surfaces 44 and 48 modify the vergence of the light from the imaging assembly to create a virtual image in front of the user at a distance of between 25 cm (close) and infinity. The distance of the virtual image may be set by selection of the focal length of the lens surfaces 44 and 48 and by adjustment of the distances between the lens surfaces 44 and 48 and the imaging assembly. Other folds using mirrors may be added to the optical path to

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relay the light on other optical paths if desired, or the light may be relayed by total internal reflections occurring along the sides of the relay 26.

[0016] The display device utilizes largely transparent relay optics. Figs. 1-3 illustrate in particular a "see-around" example. The relay 26 serves both as a mechanism for transmitting the image to the eyepiece assembly, and also as a structural member for supporting the eyepiece assembly in the user's field of view. Since the relay 26 is transparent, the occlusion of the user's visual field is minimal or for certain designs, zero, and the obscuration of the user's face is minimal. Alternatively, a cover could be placed over or formed within the optical element to block ambient light from passing through the optical element if desired, for example, to reduce glint or other undesirable reflections. Additionally, if a hinge is provided within the unit, discussed further below, the optical element 14 can be swung out of the user's visual field when not in use, so that the obscuration can conveniently be eliminated. The display device thereby provides a miniature, clear, optical element 14 so that the user's vision is not significantly impeded by the presence of the display. Additionally, the display device can be made very small, because the imaging assembly is located at the side of the user's eyeglasses, thereby minimizing the amount of structure in front of the user's eye.

[0017] Referring to Figs. 4 through 6, the housing assembly 16 comprises a body 60, preferably having an open side 62 which is covered by one or more coverplates. In the example shown, two coverplates 64,66 are used. The components are mounted within a cavity 68 in the body. Data or images may be relayed to the device by a cable 70 which enters the body 60 through an aperture 72 at one end thereof. The cable may comprise wire, one or more optical fibers as described in U. S. Patent No. 5,715,337, or a fiber optic coherent bundle image conduit. Alternatively, the data or images may be relayed to the device by radio frequency (RF) transmission.

[0018] The coverplates 64 and 66 are affixed to the body 66 in any known manner, such as with screws or adhesive, after insertion of the components. The components include a flexible circuit 74 made of Kapton or other material known in the art, upon which is provided metal conductors or traces which connect the various components, such as terminating resistors 76,78 to input cable 70. The flexible circuit also connects the cable to one or more LEDs that form the backlight 42, and the second flexible circuit 80 that connects the system to the display 40. The display is visible through an opening 82 in the coverplate.

[0019] Referring to Fig. 6, the optical element 14 may be affixed to the coverplate 66 at a collar 84. The collar may be affixed to the coverplate in any known manner or may be formed integrally with the coverplate, such as by molding. The optical element 14 may be held in place by friction so that adjustments in focus may be made by the user, simply by moving the optical element 14 with respect to the imaging assembly, by sliding the optical element within the collar 84. A friction lock may be added to lock the optical element in a desired position relative to the imaging assembly, as would be known by those of skill in the art. Alternatively, the optical element may be fixed in place by adhesive, screws, or any other manner known in the art. In this case, the position of the optical element 14 in the collar is adjusted during assembly to provide the required distance between the optical surfaces of the optical element and the imaging assembly. Typically this distance is 10 to 15 mm, but it can be zero if the cavity between the imaging assembly and the entrance surface 44 of the optical element 14 is filled with index of refraction-matched epoxy.

[0020] The clamping assembly 36 may be affixed to the housing assembly in any suitable manner. For example, the mounting fixture 38 may be adhesively or otherwise fastened to the coverplate 64. The clamps 40 may be configured to allow the display device to be positioned at a variety of elevations with respect to the temple. In another variation, the body 60 may be attached to the mounting fixture 38 by a rotary joint formed by discs 650 and 660, as illustrated in Fig. 15. These discs rotate with respect to each other about a central pivot point and may have click stops built within to hold the device at various predefined angles with respect to the eyeglass temples, as would be known by those of skill in the art.

[0021] In an alternative example, the optical element 14 may be mounted on a swivel fixture 90 as shown in Figs. 7 through 8. The swivel fixture 90 pivots around a pin 92 so that the device can fold up in a compact form for storage or convenience while remaining attached to the eyeglasses.

[0022] An embodiment of the present invention includes a non-occluded design of optical element 114, as shown in Fig. 9. In this design, the eyepiece assembly 128 comprises a polarization beam-splitter coating 129, quarterwave plate 131, and focusing mirror 130. Polarized light from the display is passed by the beamsplitter coating 129, through the quarterwave plate 131, to the focusing mirror 130. The reflected light passes again through the quarterwave plate 131, and the light, having passed twice through the properly oriented quarterwave plate, has a polarization which is rotated in a direction orthogonal to the original polarization, and the light is therefore reflected by the coating 129 to the eye, as shown by light ray 135. Light having polarization oriented properly with respect to the beam splitter 129 from the ambient beyond the device, represented by light ray 137, passes through the eyepiece.

[0023] Yet another example is shown in Fig. 10. The image is relayed from an image assembly in the housing 226 to the eye lens 232 by an image relay comprising a graded index lens 211 and mirrors 215 and 228. Alternatively, the relay may comprise a coherent fiber bundle or conventional lens relay. Such image relays may be formed from polished glass to reduce the obscuration and to improve peripheral vision. This example further

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removes obscuring surfaces from the user's face. The device functions in the following way. The image is provided by a display as previously described. The image is placed at the focal plane of the relay 211. For the graded index relay, this is accomplished through a reflection at mirror 213, so that the object image is at the entrance pupil of the relay system. The relay forms an image at its distal end which is relayed to the eyepiece assembly 228 by a mirror 215.

[0024] Fig. 11 illustrates another example of the remountable display device. In this example, the light is relayed from an imaging assembly in the housing 366 along an optical conduit 313 to a reflective surface 315. The reflective surface may comprise a polished glass surface, in which the reflection occurs by total internal reflection, or it may comprise a metal or other coating intended to reflect the rays from the imaging assembly within the display housing toward the eyepiece assembly 319 along the light path 317. Any number of folds of this type may be incorporated to cause the eyepiece and housing assembly to be placed in convenient, ergonomic, or aesthetic locations. For example, for convenience, the housing assembly may be fixed to the frame 318 in a position in which it is easy to attach or detach the device. Ergonomic considerations include obtaining a degree of balance in the device which can be the result of placing the housing and part of the optical conduit over the frame so that the device's center of gravity resides over the frame. Aesthetic considerations include minimizing the amount of surface area of the device around the user's face.

[0025] Figs. 12 and 13 illustrate a further example of the display device with a link element 411 that connects the imaging assembly and optical element 414 to the housing assembly 416. The housing assembly includes a main body 460 which contains the connections for the cable and the flexible circuits as well as electronic components. A further body 466 supports the imaging assembly. The link element 411 connects the main body 460 and the further body 466 and provides a support for wires connecting the components in the main body with the imaging assembly. The link element allows the optical element to be folded out of view, as shown in Fig. 12, without adjusting the mounting mechanism that attaches the housing to the temple of the user's eyeglasses. The link element also allows some adjustment of the position of the optical element in front of the eyeglass lens.

[0026] Fig. 14 illustrates a method of remountably attaching the device to the eyeglass frame front 700. A clamping apparatus 701 hinged at point 710 and drawn together by spring 703 is affixed to the bottom of the frame front below the lens. The clamp may be shaped in a manner similar to the curvature of the frame to provide increased contact area between the clamp and the frame front. Small handles 720 are provided to apply force against the spring 703 to release the clamp. Affixed to the clamp 701 is the housing 90 of the display device that has been previously described. The optical relay 26 extends into the user's main field of view to provide an image. Any of the foregoing adjustments and pivots may be implemented in order to position the image at a location convenient for viewing.

[0027] Alternative examples include various forms of eyepiece, illumination optics, and mounting fixtures. Two display devices operated in cooperation, one device in front of each of the two lenses of a pair of eyeglasses, can also be used if desired to provide a binocular display.

[0028] The invention is not to be limited by what has been particularly shown and described, except as indicated by the appended claims.

Claims

1. A compact, remountable display device (10) for eyewear having a head-borne frame, the display device (10) comprising:

   a housing assembly (16) having a mounting mechanism disposed to removably mount to the head-borne frame of the eyewear at a location outside a user's main field of view;
   circuitry (22) disposed within the housing assembly (16) to receive data or video signals;
   an electronic imaging assembly (12) supported by the housing assembly (16) outside of the user's main field of view and in communication with the circuitry (22) within the housing assembly (16) to produce an image; and
   an optical element (114) comprising:

      a transparent fixture for supporting an eyepiece assembly (128) in front of a user's eye, the fixture located to receive the image from the electronic imaging assembly and capable of relaying the image internally; and
      an eyepiece assembly (128) supported by the transparent fixture to direct an image to the user's eye;

   characterised in that the eyepiece assembly (128) comprises a polarization beam-splitter coating (129), a quarterwave plate (131), and a focusing mirror (130) arranged so that polarized light from the imaging assembly (12) passes the beam-splitter coating (129) and the quarterwave plate (131) and is reflected from the focusing mirror (130) to pass in the opposite direction through the quarterwave plate (131) and is reflected from the beam-splitter coating (129) toward the eye.

2. The device of claim 1, wherein the mounting mechanism is disposed to removably mount to a temple of the head-borne frame of the eyewear.

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3. The device of claim 1 or claim 2, wherein the transparent fixture comprises an optical relay (126) defining an optical path therethrough.

4. The device of claim 1 or claim 2, wherein the transparent fixture comprises an optical relay (126) having first and second surfaces disposed to permit transmission of ambient light, the first and second surfaces further being optically parallel.

5. The device of claim 1 or claim 2, wherein the transparent fixture comprises an optical relay (126), the optical relay (126) being optically clear and having a uniform index of refraction within at least a main field of view of the user.

6. The device of claim 1 or claim 2, wherein the transparent fixture further includes a cover to block ambient light from passing through the transparent fixture to the user's eye.

7. The device of claim 1 or claim 2, wherein the imaging assembly (12) comprises a miniature flat panel display.

8. The device of claim 7, wherein the display has a screen diagonal of less than 2 cm.

9. The device of claim 1 or claim 2, wherein the imaging assembly (12) comprises a transmissive or reflective miniature active matrix liquid crystal display, an electroluminescent display, or a scanning display.

10. The device of claim 1 or claim 2, wherein the housing assembly (16) comprises an elongated body having an open side and at least one cover plate (64, 66) disposed to cover the open side.

11. The device of claim 2, wherein the mounting mechanism comprises a clamping device (36) disposed to clamp the housing assembly to the temple of the head-borne frame.

12. The device of claim 1 or claim 2, wherein the mounting mechanism is configured to adjust the elevation of the optical element with respect to the user's eye.

13. The device of claim 1 or claim 2, wherein the mounting mechanism includes a rotatable mechanism configured to rotatably adjust the optical element with respect to the user's eye.

14. The device of claim 1 or claim 2, wherein the housing assembly includes a collar (84), and the optical element is movably supported within the collar (84) to provide a focusing adjustment.

15. The device of claim 1, wherein the transparent fixture has a uniform index of refraction and includes first and second optically parallel surfaces disposed to permit transmission of ambient light to the user's eye.

16. The device of claim 15, wherein the transparent fixture comprises an optical relay (26) defining an optical path therethrough.

Patentansprüche

1. Kompakte, wiedermontierbare Displayvorrichtung (10) für eine Brille mit einem am Kopf getragenen Rahmen, wobei die Displayvorrichtung (10) umfasst:

   eine Gehäusebaugruppe (16) mit einem Befestigungsmechanismus, der derart angeordnet, dass er entfernbar an dem am Kopf getragenen Rahmen der Brille an einem Ort außerhalb des Hauptsichtfelds eines Benutzers befestigt ist;
   Schaltungen (22), die innerhalb der Gehäusebaugruppe (16) angeordnet sind, um Daten oder Videosignale zu empfangen;
   eine elektronische Bildgebungsbaugruppe (12), die durch die Gehäusebaugruppe (16) außerhalb des Hauptsichtfelds des Benutzers gestützt wird und in Kommunikation mit den Schaltungen (22) innerhalb der Gehäusebaugruppe (16) steht, um ein Bild zu erzeugen; und
   ein Optikelement (114), umfassend:

      eine transparente Halterung, um eine Okularbaugruppe (128) vor einem Auge eines Benutzers zu stützen, wobei die Halterung angeordnet ist, um das Bild von der elektronischen Bildgebungsbaugruppe zu empfangen, und fähig ist, das Bild intern weiterzuleiten; und
      eine Okularbaugruppe (128), die von der transparenten Halterung gestützt wird, um ein Bild zum Auge des Benutzers zu lenken;

   dadurch gekennzeichnet, dass die Okularbaugruppe (128) eine Polarisationsstrahlteilerbeschichtung (129), eine Viertelwellenplatte (131) und einen Fokussierspiegel (130) umfasst, der derart angeordnet ist, dass das polarisierte Licht von der Bildgebungsbaugruppe (12) durch die Strahlteilerbeschichtung (129) und die Viertelwellenplatte (131) hindurchgeht und von dem Fokussierspiegel (130) reflektiert wird, um in der entgegengesetzten Richtung durch die Viertelwellenplatte (131) hindurchzugehen und von der Strahlteilerbeschichtung (129) zum Auge reflektiert zu werden.

2. Vorrichtung nach Anspruch 1, wobei der Befestigungsmechanismus derart angeordnet ist, dass er

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an einem Bügel des am Kopf getragenen Rahmens der Brille entfernbar befestigt ist.

3. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die transparente Halterung eine Lichtübertragung (126) umfasst, die einen optischen Weg dort hindurch definiert.

4. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die transparente Halterung eine Lichtübertragung (126) umfasst, die erste und zweite Flächen aufweist, welche angeordnet sind, um die Übertragung von Umgebungslicht zu erlauben, und die ersten und zweiten Flächen weiter optisch parallel sind.

5. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die transparente Halterung eine Lichtübertragung (126) umfasst und die Lichtübertragung (126) optisch klar ist und einen gleichförmigen Brechungsindex innerhalb von mindestens einem Hauptsichtfeld des Benutzers aufweist.

6. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die transparente Halterung weiter eine Abdeckung umfasst, um Umgebungslicht daran zu hindern, durch die transparente Halterung zum Auge des Benutzers hindurchzugehen.

7. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die Bildgebungsbaugruppe (12) ein Miniaturflachdisplay umfasst.

8. Vorrichtung nach Anspruch 7, wobei das Display eine Bildschirmdiagonale von kleiner als 2 cm aufweist.

9. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die Bildgebungsbaugruppe (12) ein lichtdurchlässiges oder reflektierendes Miniaturaktivmatrix-Flüssigkeitskristalldisplay, ein Elektrolumineszenzdisplay oder ein Scanningdisplay umfasst.

10. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die Gehäusebaugruppe (16) einen länglichen Körper umfasst, der eine offene Seite und mindestens eine Abdeckplatte (64, 66) aufweist, die angeordnet ist, um die offene Seite abzudecken.

11. Vorrichtung nach Anspruch 2, wobei der Befestigungsmechanismus eine Klemmvorrichtung (36) umfasst, die angeordnet ist, um die Gehäusebaugruppe am Bügel des am Kopf getragenen Rahmens festzuklemmen.

12. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei der Befestigungsmechanismus konfiguriert ist, die Höhe des Optikelements in Bezug auf das Auge des Benutzers anzupassen.

13. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei der Befestigungsmechanismus einen drehbaren Mechanismus umfasst, der konfiguriert ist, das Optikelement in Bezug auf das Auge des Benutzers drehbar anzupassen.

14. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die Gehäusebaugruppe einen Kragen (84) umfasst und das Optikelement innerhalb des Kragens (84) beweglich gestützt wird, um eine Brennweiteneinstellung bereitzustellen.

15. Vorrichtung nach Anspruch 1, wobei die transparente Halterung einen gleichförmigen Brechungsindex aufweist und erste und zweite optisch parallele Flächen umfasst, die angeordnet sind, um die Übertragung des Umgebungslichtes zum Auge des Benutzers zu erlauben.

16. Vorrichtung nach Anspruch 15, wobei die transparente Halterung eine Lichtübertragung (26) umfasst, die einen optischen Weg dort hindurch definiert.

Revendications

1. Dispositif d'affichage (10) compact, remontable, pour lunettes comportant une monture, le dispositif d'affichage (10) comprenant :

   un ensemble formant le boîtier (16) ayant un mécanisme de montage disposé pour se fixer de façon amovible à la monture des lunettes, à un endroit situé en dehors du champ de vision principal de l'utilisateur ;
   un circuit (22) disposé à l'intérieur de l'ensemble formant le boîtier (16) pour recevoir des données ou des signaux vidéo ;
   un ensemble d'imagerie électronique (12) supporté par l'ensemble formant le boîtier (16) à l'extérieur du champ de vision principal de l'utilisateur et en communication avec le circuit (22) à l'intérieur de l'ensemble formant le boîtier (16) afin de produire une image ; et
   un élément optique (114) comprenant :

      une installation transparente pour tenir un ensemble oculaire (128) en face de l'oeil de l'utilisateur, l'installation étant positionnée pour recevoir l'image de l'ensemble d'imagerie électronique et être capable de relayer l'image en interne ; et
      un ensemble oculaire (128) tenu par l'installation transparente pour diriger une image vers l'oeil de l'utilisateur ;

   caractérisé en ce que

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l'ensemble oculaire (128) comprend un revêtement séparateur de faisceaux polarisant (129), une lame quart d'onde (131), et un miroir de focalisation (130) disposés de sorte que la lumière polarisée provenant de l'ensemble d'imagerie (12) passe par le revêtement séparateur de faisceaux (129) et la lame quart d'onde (131) et est réfléchie par le miroir de focalisation (130) pour passer dans la direction opposée à travers la lame quart d'onde (131) et est réfléchie par le revêtement séparateur de faisceaux (129) vers l'oeil.

2. Dispositif selon la revendication 1, dans lequel le mécanisme de fixation est disposé pour se fixer de façon amovible à la monture des lunettes.

3. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'installation transparente comprend un relais optique (126) définissant un trajet optique la traversant.

4. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'installation transparente comprend un relais optique (126) ayant une première et une seconde surfaces disposées pour permettre la transmission de la lumière ambiante, les première et seconde surfaces étant en outre optiquement parallèles.

5. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'installation transparente comprend un relais optique (126), le relais optique (126) étant optiquement transparent et ayant un indice de réfraction uniforme dans au moins un champ de vision principal de l'utilisateur.

6. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'installation transparente comprend en outre un couvercle pour empêcher la lumière ambiante de passer à travers l'installation transparente jusqu'à l'oeil de l'utilisateur.

7. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'ensemble d'imagerie (12) comprend un écran plat miniature.

8. Dispositif selon la revendication 7, dans lequel l'affichage a une diagonale d'écran inférieure à 2 cm.

9. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'ensemble d'imagerie (12) comprend un écran miniature à cristaux liquides à matrice active transmissif ou réfléchissant, un affichage électroluminescent ou un affichage à balayage.

10. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'ensemble formant le boîtier (16) comprend un corps allongé ayant un côté ouvert et au moins une plaque de recouvrement (64, 66) disposée de façon à couvrir le côté ouvert.

11. Dispositif selon la revendication 2, dans lequel le mécanisme de montage comprend un dispositif de serrage (36) disposé pour serrer l'ensemble formant le boîtier au niveau de la tempe de la monture.

12. Dispositif selon la revendication 1 ou la revendication 2, dans lequel le mécanisme de montage est configuré pour ajuster l'élévation de l'élément optique par rapport à l'oeil de l'utilisateur.

13. Dispositif selon la revendication 1 ou la revendication 2, dans lequel le mécanisme de montage inclut un mécanisme rotatif configuré pour ajuster par rotation l'élément optique par rapport à l'oeil de l'utilisateur.

14. Dispositif selon la revendication 1 ou la revendication 2, dans lequel l'ensemble de boîtier inclut un collier (84), et l'élément optique est soutenu de façon mobile à l'intérieur du collier (84) pour fournir un ajustement de focalisation.

15. Dispositif selon la revendication 1, dans lequel l'installation transparente a un indice de réfraction uniforme et inclut une première et une seconde surfaces optiquement parallèles disposés pour permettre la transmission de lumière ambiante à l'oeil de l'utilisateur.

16. Dispositif selon la revendication 15, dans lequel l'installation transparente comprend un relais optique (26) définissant un trajet optique la traversant.

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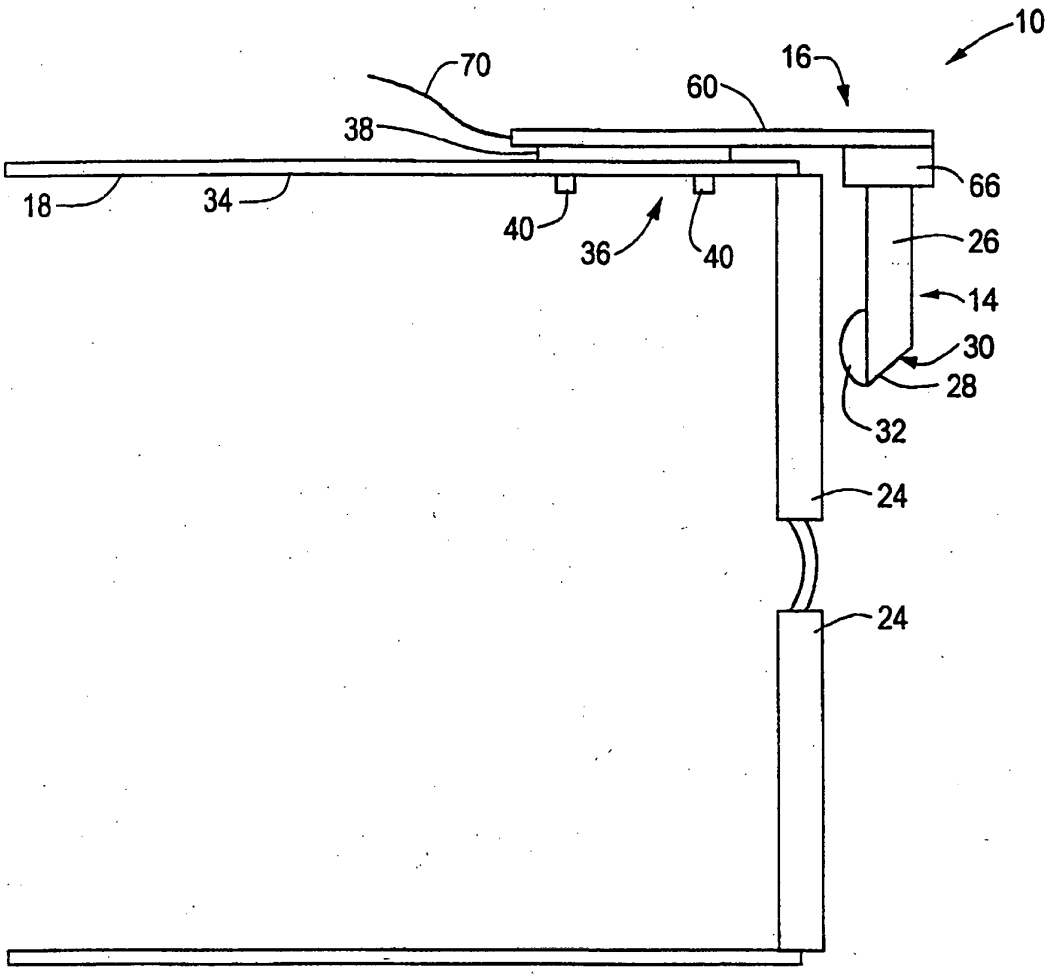

FIG. 1

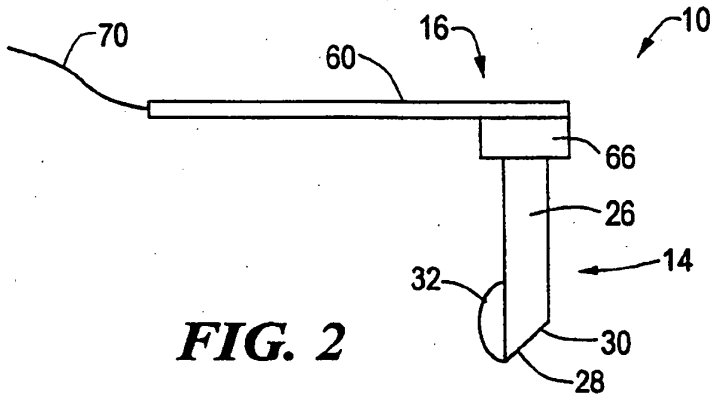

FIG. 2

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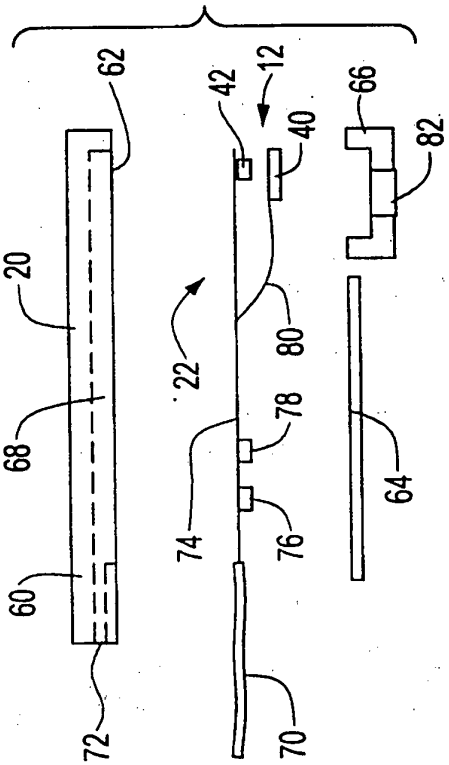

FIG. 4

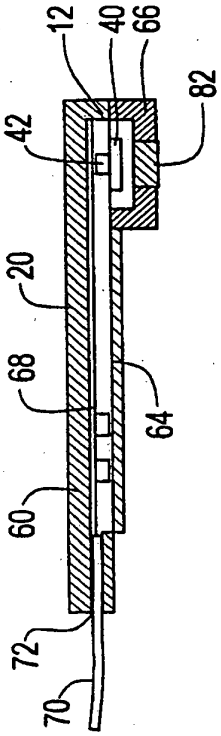

FIG. 5

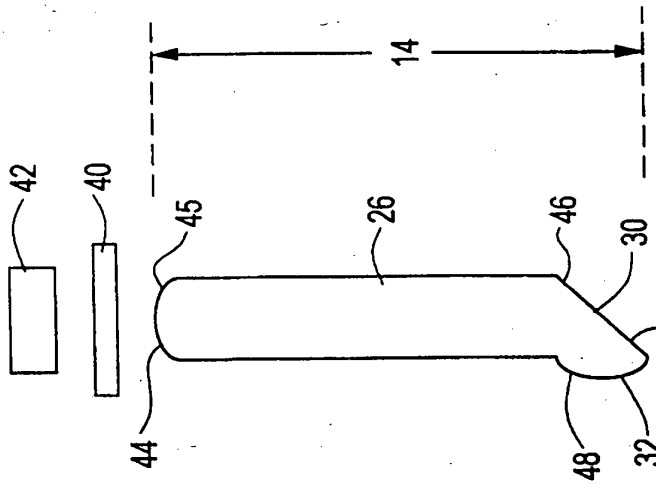

FIG. 3

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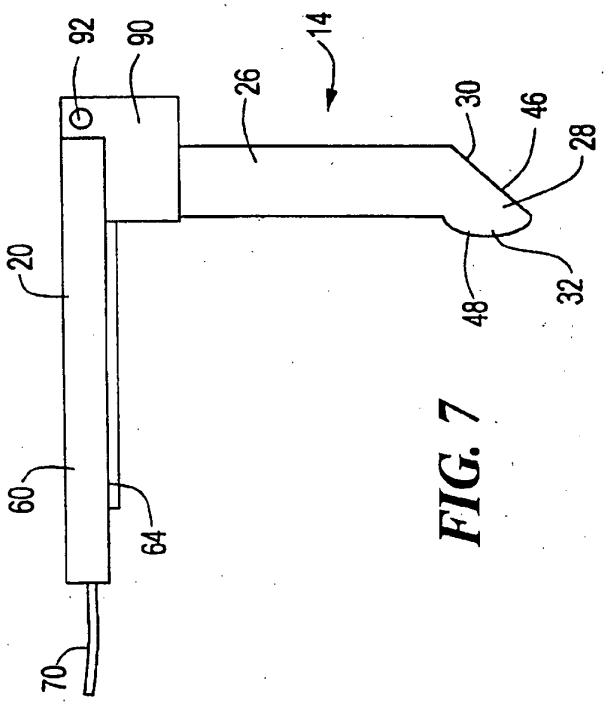

FIG. 7

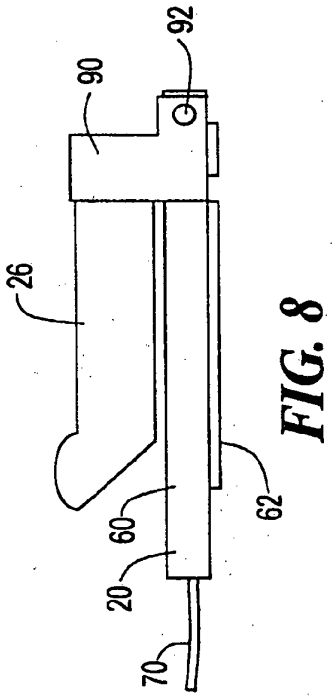

FIG. 8

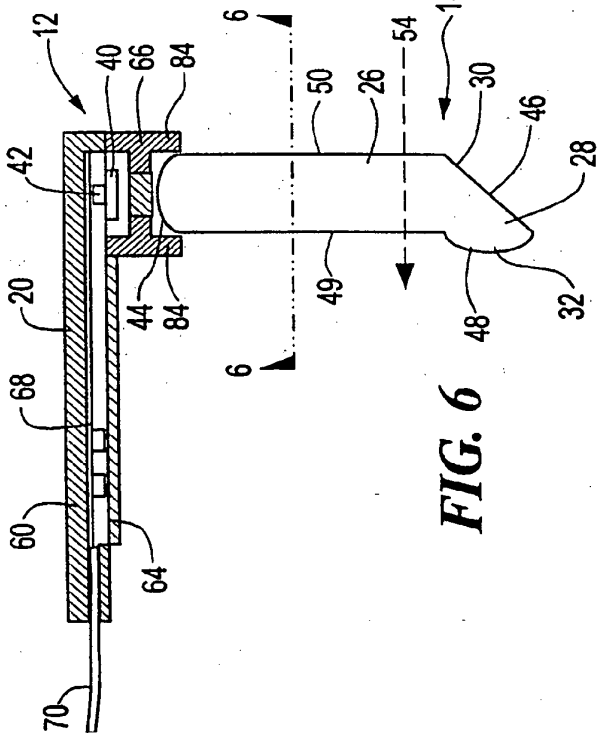

FIG. 6

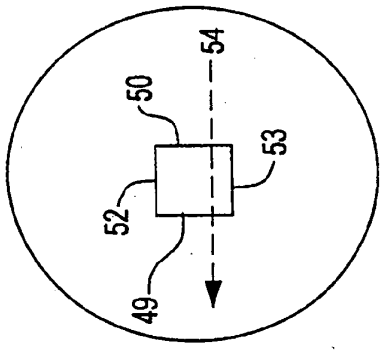

FIG. 6a

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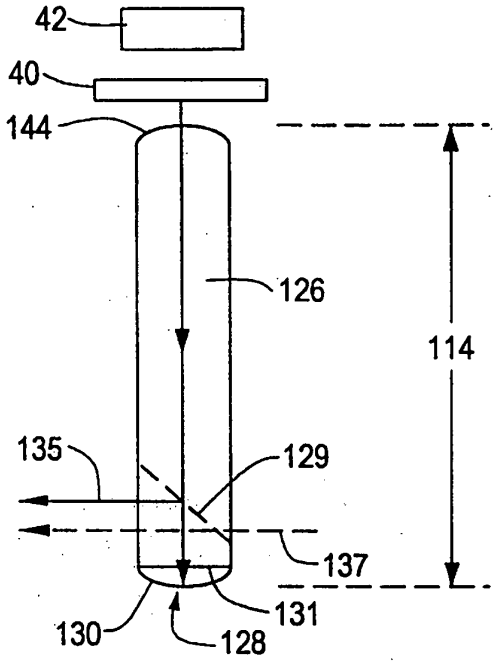

FIG. 9

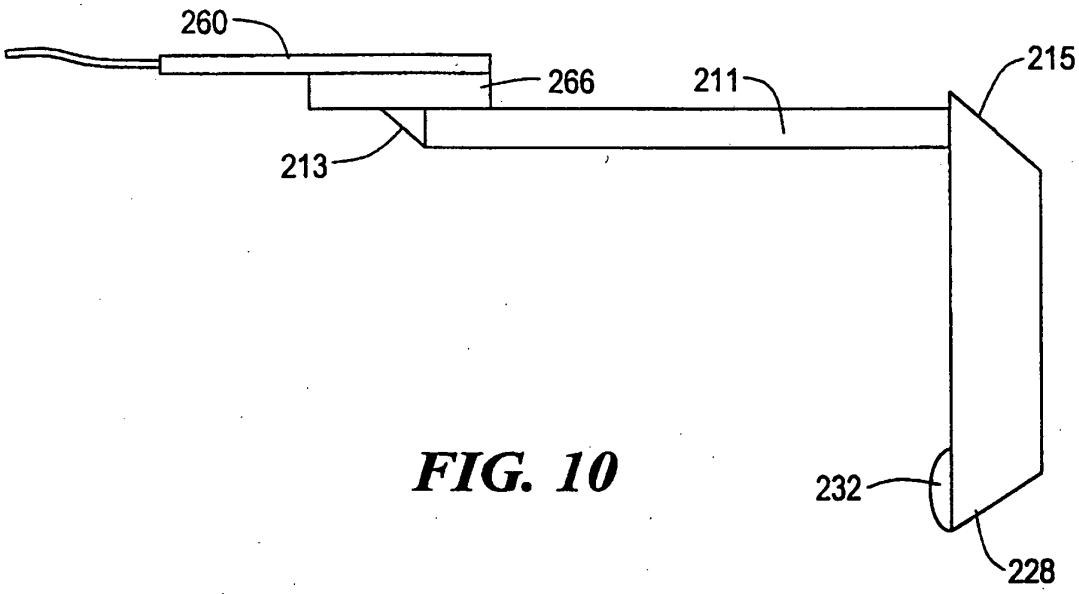

FIG. 10

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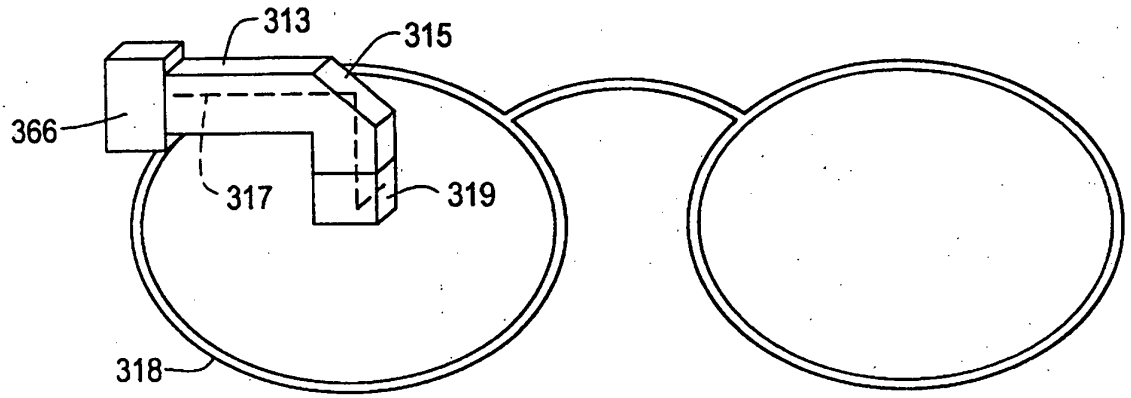

FIG. 11

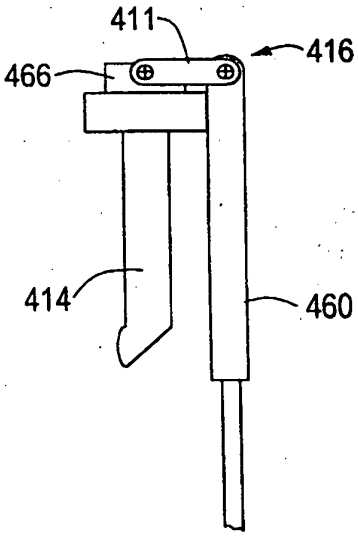

FIG. 12

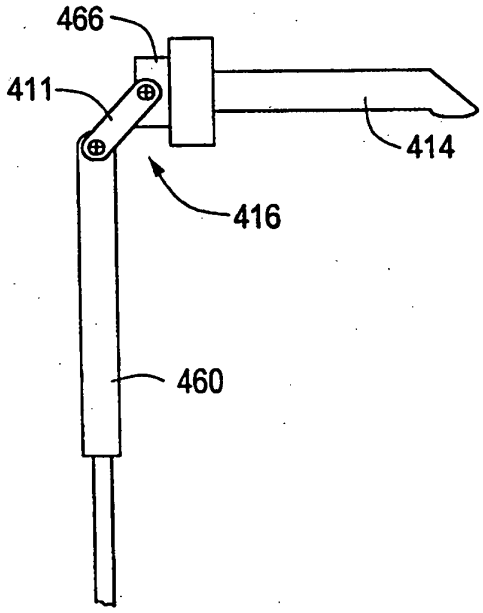

FIG. 13

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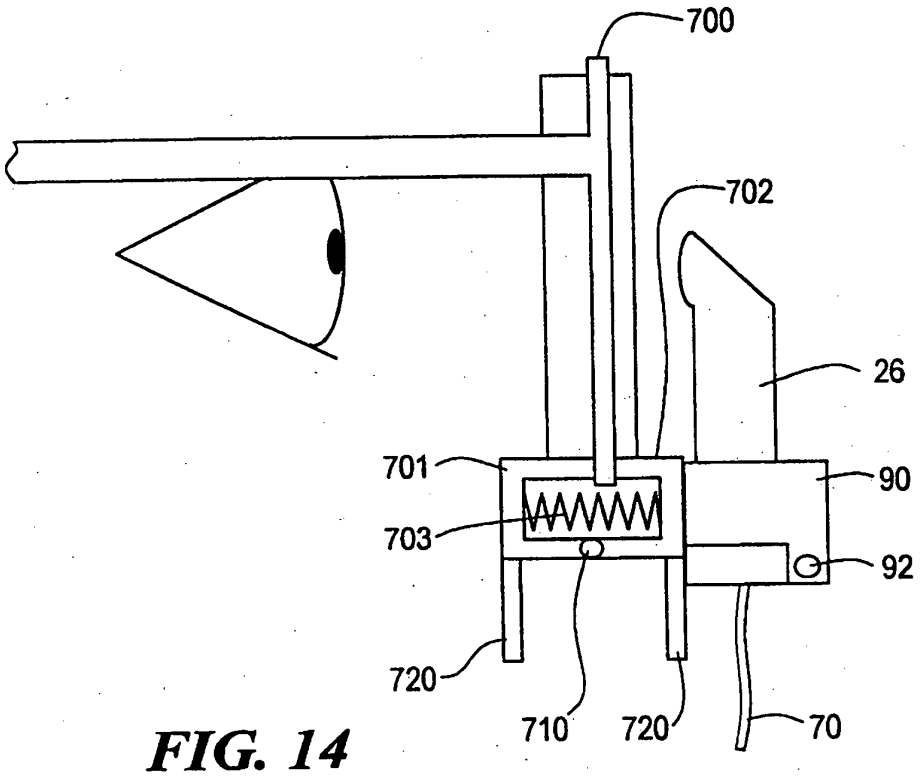

FIG. 14

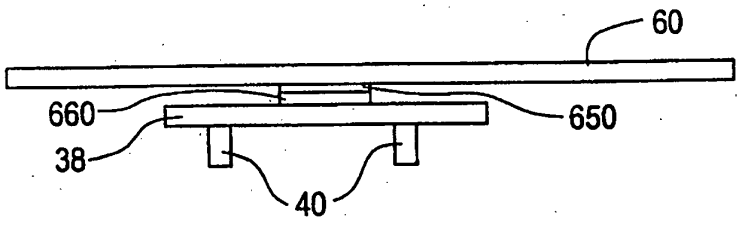

FIG. 15

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REFERENCES CITED IN THE DESCRIPTION

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F21V 21/088 *(2006.01)*

(54) LIGHTED READING GLASSES

BELEUCHTETE LESEBRILLE

LUNETTES DE LECTURE ECLAIRANTES

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14.05.2002 US 145595

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US-A- 6 056 413

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EP 2 290 433 B1

Description

Field of the Invention

[0001] The present invention relates generally to lighted glasses and, more particularly, to eyeglasses that are especially well-suited for reading in poorly lit areas.

Background

[0002] The use of lights and other illuminating devices with glasses is known. Generally, however, they have not been very well adapted for use with reading glasses. As is known, these types of glasses typically are not worn all the time, and are subject to being frequently taken off and put back on. On the other hand, when reading glasses are worn, they should be comfortable enough to encourage their use so that people are not avoiding their glasses and instead straining their eyes to read.

[0003] Incandescent light bulbs commonly have been proposed for use with lighted glasses. Unfortunately, such lighting devices generate a significant amount of heat Smaller, less powerful incandescent lights still may make the wearer feel quite uncomfortable after even a short while due to the proximity of the light source and the wearer's face. Further decreasing the size of the incandescent lights, to the point where the wearer is comfortable, may cause light output to be very dim and therefore unusable for illuminating reading material that are held at distances optimal for reading.

[0004] For example, if reading distance after using corrective lenses for those in need of vision correction of ordinary size text, e.g. 10 or 12 point font, is optimally ten to eighteen inches from the eyes, a light that is capable of brightly illuminating the pages within that range of distances is necessary for ensuring comfort in reading in dimly lighted areas. However, a lower intensity light bulb, which may be preferable to reduce heat or increase battery life, may result in less than optimal lighting at the optimal reading distance, causing eye-strain and discomfort. In other words, the lower intensity of the light source will result in a decrease in the brightness of the light on the page so that the text to be read is only dimly lit

[0005] The use of fiber optic lighting devices instead of incandescent light bulbs is known. In such devices, optical fibers are bundled together to create a light producing device. The nature of fiber optics is such that there is no heat generated at the point where the light is typically transmitted; that is, adjacent the user's temple. Unfortunately, such devices suffer from a rather major limitation. Namely, a very intense and powerful light source must be available to provide light to the optical fibers. As such, head gear such as worn by surgeons having a fiber optic lighting device must at all times stay tethered to a fiber optic light source, which severely restricts the mobility of the user and thus the ease of use of the headgear. A portable light source that stays connected to the fiber optic light head via electrical cables is less than desirable in terms of the need to be able to conveniently carry the light source, and the inconveniences associated with dangling connecting lines.

[0006] An additional problem that exists with fiber optic devices, as well as incandescent lighting devices, is rapid battery consumption. Incandescent light bulbs are known to consume large amounts of power. Similarly, a fiber optic device, since it requires a strong lighting source, also requires a large amount of power. As a result, the user is be forced to change batteries often or stay tethered to a constant power source or light source.

[0007] Another disadvantage in prior art lighting devices is the manner in which surfaces are illuminated. Lighting devices used in the medical field generally produce a single fixed narrow beam of light to brightly illuminate the particular stationary body area on which the doctor may be operating. However, such a single narrow beam would not be particularly helpful in reading textual material as the beam would have to be continually shifted across the page being read. On the other hand, lights used with glasses generally tend to be very inefficient in their use of the light they generate as large amounts of light are cast beyond the field of view of the glasses. Adjustable lights are less than desirable as they require a user to make sure the lights are properly positioned each time the glasses are used.

[0008] Accordingly, there is a need for lighted glasses that are optimized for use in poorly lit or dim areas. More particularly, reading glasses having lights that are arranged to direct an optimum, amount of light to the area where it is required most, i.e. the reading area, is needed. Further, lights that are very compact and lightweight, while still providing the necessary lighting strength and having a sufficiently long life for the power source that power these lights would be desirable.

[0009] DE 94108862 U1 disclose a carryable minilighting device for which a light bulb mount can be attached to glasses and supplied with power from a power pack through a wire extending therebetween. US 4,959,760 discloses lighting equipment for eyeglasses.

Summary of the Invention

[0010] In accordance with one form of the invention, lighted glasses, and preferably those adapted for reading which include corrective lenses, e.g. magnifiers, are provided to enable conventional sized text to be clearly read in dimly lit areas when held at a normal range of reading distances at which a user typically reads such material, such as between ten inches and eighteen inches from the lenses. High strength lights and light mounts therefor cooperate to light the reading area with a maximum amount of light provided in the reading distance range. More particularly, highly efficient and high intensity light emitting diodes (LEDs) are mounted in housings configured to fix narrow beams of light to be directed slightly inward toward each other so that the beams overlap in the reading distance range thus providing double the

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amount of light for reading over that provided by a single one of the lights. To this end, the housings are attached adjacent outer portions of the lenses so that the inwardly directed light beams light up the areas generally in front of the glasses, i.e. in its field of view, and which begins spaced forwardly therefrom, i.e. generally coinciding with the start of the reading distance range. Further, the small size and efficient nature of the preferred solid-state material, i.e. InGaN (indium gallium nitride), for the LEDs, allows very small power supplies to be used such as disc-shaped coin cell batteries for powering the LEDs which, in turn, allows both the light source and power source herein to be self-contained in a highly compact housing therefor. In this regard, the present invention provides compactly sized lighting modules as described above that can be attached to reading or other glasses either removably or fixed in a more permanent fashion as described hereinafter.

[0011] The beams of light from the LEDs generate conical-shaped lighted areas such that upon intersection they cooperate to form a conical overlapping lighted area in which the brightness of the light is effectively doubled over that provided by a single LED. The conical overlapping lighted area increases in size as distances increase from the lenses. As is known, light tends to dissipate the further it is from its source. The overlapping conical lighted area is such that the peripheral areas in the field of view of the lenses that do not receive the double light strength of the overlapping light beams are closest to the lenses where light dissipation has its least effect in the reading distance range, whereas the overlapping lighted area increases in size further from the lenses with a corresponding decrease in the single light strength peripheral areas on either side of the cone of overlapping light. Thus, as light dissipates and distances increase from the lenses, the lighting provided will not suffer as the double light strength of the overlapping conical region of light will more than make up for the effects of light dissipation in the reading distance range.

[0012] To achieve the optimum amount of light flooding in the reading area, the light housings have surfaces configured to orient the central axis of the conical light beams in a direction that is canted slightly inward with the beams directed toward each other. The preferred canting of the narrow light beams which in the preferred and illustrated form are cones forming angles of twenty degrees is such that the cone axis has a fifteen degree angle with a reference line extending straight forwardly from the lenses. The lenses are preferably magnifiers of a predetermined diopter rating selected by a user so that conventionally sized text such as ten or twelve point font can be clearly read at distances ranging from between approximately ten and eighteen inches forwardly of the user. And it is in this distance range where the overlapping cone of light is formed by the conical light beams canted inward toward each other, as described. In this way, the present lighted reading glasses are provided with lights whose light beams are directed in a carefully coordinated manner with the vision correction provided by the corrective reading lenses so that the amount of light is maximized where it is needed most, i.e. in the field of view of the lenses and within the range of distances at which conventional sized printed text is most commonly read.

[0013] The glasses include temple arms that extend rearwardly from the outer portions of the lenses with the housings attached to the arms toward the forward ends thereof. The temple arms can be opened for use or folded when not in use. With the temple arms opened, the housings are each oriented to project light therefrom forwardly inwardly and toward the light emanating from the housing attached on the other arm. The temple arms toward their forward ends typically will extend substantially straight rearwardly generally normal to the lens frame portions so that the longitudinal axis of the housing is likewise in a normal orientation to the lens frame with the mounting surfaces of the housing configured to be canted inwardly therefrom to direct the light beams as earlier described. Should the configuration of the temple arms and/or housings vary from that described herein, the mounting surfaces can be configured to adapt accordingly such that the light beams are inwardly directed as desired.

[0014] The LEDs herein are a small lightweight device that provide a very bright light, while consuming very little power. As such, the batteries enclosed in the housing are small and do not need to be changed as frequently as devices that utilize incandescent lights or fiber optics, which require large batteries. The LEDs provide a relatively narrow beam of light that can be well focused in a particular direction. For example, if two light modules are mounted on a pair of glasses, the LEDs in each module are positioned such that the cones of light produced by the LEDs in the light modules begin intersecting at a point closely adjacent to or coinciding with the start of the range of ideal reading distances. As such, the illuminated reading portion receives the brightest light possible since the intersection of both cones of light are trained on that area. Another advantage of using the high intensity LEDs is that because they consume such a small amount of power, virtually no heat is dissipated. Therefore, a user is able to wear eyeglasses having the light modules mounted thereon, for longer periods of time without suffering from heat and without being bothered by the weight of the devices.

[0015] In another form, the light modules are provided with spring clips that are attached to the light module housing. The spring clips are preferably a resilient material such as metal or sturdy plastic. The spring clips enable the light module to be removably attached to any pair of eyeglasses. Alternatively, the modules can be fixed at ends of a clip-on frame with a clip mechanism intermediate the ends for releasably securing the clip-on frame to eyeglasses in the general area of the nose bridge and adjacent lens portions thereof.

[0016] In still another form not according to the invention as claimed, the lights such as provided in the aforedescribed light modules are fixedly mounted to a clip-on

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light apparatus for being removably secured to eyeglasses. Preferably, the clip-on frame is adjustable so that it can be fit onto differently sized eyeglasses. More particularly, the frame is an elongate spacer frame having end portions to which lights are mounted. An adjustment assembly or draw spring assembly of the spacer frame spring biases the end portions toward each other. At the end portions, retainer members are configured to grip onto the lenses to position the lights adjacent thereto. In particular, the light modules are mounted at the corresponding temple area of the clip-on glasses to enable the LEDs in the light modules to project light in the manner described above. To this end, the lights can include high intensity LEDs that are mounted in the light modules which orient the LEDs to project light at an inward cant relative to each other so the maximum amount of light is trained on the reading area, as previously described.

Brief Description of the Drawings

[0017]

Fig. is a perspective view of lighted reading glasses in accordance with the present invention showing the glasses used to read material held at a normal reading distance range;

Fig. 2 is a side elevational view of the reading glasses of Fig. 1 showing a lighting module attached to a forward end portion of one of the temple arms of the glasses;

Fig. 3 is a plan view of the glasses of Fig. 2 showing a light switch shifted to activate the lights to generate cones of light emanating therefrom;

Fig. 4 is a perspective view of the light module showing the compact configuration of a housing of the module with a slot opening for the switch and a forward opening for the light in the form of an LED;

Fig. 5 is an exploded view of the light module of Fig. 4 showing a pair of coin cell batteries used to power the LED;

Fig. 6 is a side elevational view of the light module showing the coin cells in phantom and the tapered configuration of the housing from the widest diameter to hold the coin cells therein;

Fig. 7 is a front elevational view of the light module showing the thin configuration of the housing;

Fig. 8 is a cross-sectional view taken along line 8-8 of Fig. 6 showing light mounting surfaces for orienting the LED to project light at an oblique angle to a longitudinal axis of the housing;

Fig. 8A is an enlarged fragmentary view of the forward portion of the module to show more clearly the preferred angle at which the LEDs are mounted in the housing;

Fig. 9 is a diagramatic view of the lighted glasses showing the respective inwardly directed cones of light produced by each of the light modules and the overlapping lighted area they create in the reading distance range;

Fig. 10 is a side elevational view of a light module having spring-clips for being removable attached to the glasses;

Fig. 11 is a front elevational view of the light module of Fig. 10 showing a ridged surface on a resilient arm of one of the clips;

Fig. 12 is a plan view of a light module, not according to the invention as claimed, fixed to a frame to be clipped onto gasses;

Fig. 13 is a front elevational view of the lighted clip-on frame of Fig. 12;

Fig. 14 is a side elevational view of the lighted clip-on frame of Fig. 12;

Fig. 15 is a front elevational view of the lighted clip-on frame removably attached to a pair of spectacles;

Fig. 16 is a plan view of the lighting modules modified so that each include a blinder extension integral with the housing and disposed between the LEDs and the adjacent lenses;

Fig. 17 is an enlarged elevational view of the lighting module of Fig. 16;

Fig. 18A is a perspective view of a clip-on light apparatus not in accordance with the present invention, showing an adjustable frame with light modules secured at either end thereof;

Fig. 18B is a perspective view similar to Fig. 18A showing the clip-on frame removably secured to eyeglasses with the light modules adjacent the lenses;

Fig. 19 is a plan view of the clip-on light apparatus showing a draw spring assembly of the frame that allows the end portions to be pulled away from each other against the spring bias;

Fig. 20 is a front elevational view of the clip-on light apparatus showing a pair of retainers at either end of the frame that are adapted to engage the eyeglass lenses;

Fig. 21 is an enlarged plan view of one of the frame ends and light module mounted thereto showing a coilspring of the drawstring assembly in an expanded state for close positioning of the light modules relative to each other;

Fig. 22 is a view similar to Fig. 21 showing the frame end portion pulled to compress the spring from its expanded state for shifting the light modules away from each other;

Fig. 23 is a side elevational view taken along line 23-23 of Fig. 21 showing a mounting plate for attaching the frame end portion to the light module.

Fig. 24 is a perspective view of an alternative clip-on apparatus showing a frame having light modules fixed at either end with a clipping mechanism therebetween releasably securing the frame to eyeglasses;

Fig. 25 is a plan view of the alternative clip-on apparatus showing pairs of clip arms and a pivot actuator therefor; and

Fig. 26 is a cross-sectional view taken along line

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26-26 of Fig. 25 showing pivoting of the actuator for opening the pairs of clip arms.

Detailed Description of the Preferred Embodiments

[0018] As shown in drawings for purposes of illustration, the invention is embodied in lighted reading glasses 5 which enable a user wearing the glasses 5 as shown in Fig. 1 to clearly read conventionally sized printed text 10, e.g. ten or twelve point font, held in a range of distances suitable for reading such text sizes where the reading is occurring in poorly or dimly lit areas. In this regard, the present lighted reading glasses 5 are ideally suited for use in areas that normally require a user to turn on a light before reading can occur but where doing so is less than desirable, such as in a car or when reading in bed with another present who is trying to sleep while you read.

[0019] The lighted glasses 5 which as stated above are preferably reading glasses 5 will include lenses 12 of light transmissive material configured to refract light to correct for defects in vision due to errors of refraction in the human eye and thus, at least one of the lens surfaces 14 will be curved to precisely correct for the defect being addressed in a particular individual that wishes to use the lighted reading glasses 5 herein. A variety of lens types may be utilized including concave, convex, plano-convex, cylindrical, compound lenses and/or bi, tri, or tetrofocal lenses, although the reading glasses 5 are preferably adapted for use by those who are farsighted so that convexly configured lenses 12 will typically be employed. Further, although the reading glasses 5 can be provided with prescription lenses 12, from a cost standpoint the lighted glasses 5 are preferred for use with lower cost magnifier lenses 12 that have a well-defined diopter rating. In this regard, the lenses 12 can be offered with nine different diopter ratings from 1.00 up to 3.00 in intervals of 0.25 therebetween. Alternatively, the lenses 12 can be non-refractive for people who do not need vision correction but still want to read in the dark via the lighting provided by the glasses 5 herein.

[0020] With the reading glasses 5 on, the user will be able to read in dark or dimly lit areas via lights 16 that are on the glasses 5 attached by way of respective light mounts 18 therefor. The light mounts 18 fix the predetermined lighted areas 20 to be oriented so that they overlap and create an overlapping lighted area 22 which has double the amount of light and thus significantly increase brightness over that provided by a single one of the lights 16. As best shown in Fig. 9, the overlapping lighted area 22 is disposed in the predetermined reading distance range generally designated 24 by the direction afforded to the lights 16 via their light mounts 18. This range for a normal functioning eye or using an appropriate corrective lens for those requiring vision correction for reading ten or twelve point font with a sufficiently large or wide field of view will be approximately ten to eighteen inches in front of the lenses 12.

[0021] The lights 16 are, preferably high intensity, LEDs 108 that form their lighted areas 20 as narrow light beams in the shape of respective cones 136 and 138 of light directed inwardly toward each other, as shown in Figs. 3 and 9. In this manner, the point of intersection 48 will be closely adjacent or substantially coincident with the start of the reading distance range 24 and the overlapping area 22 will likewise take on a conical shape 140 and be maximized in size in the range 24. There is also a proximate conical area 25 right in front of the glasses 5 that does not receive light. However, this unlighted area 25 is of little consequence as it substantially falls before the start of the reading distance range 24.

[0022] By canting the light beams 136 and 138 inwardly, little light is wasted on areas that are outside the effective field of view, generally designated 26, of the glasses 5. Further, the conical overlap area 140 that receives double the amount of light increases in size with increasing distances from the lenses 12. By contrast, the peripheral areas 30 and 32 on either side of the double-lit overlap area 140 become smaller with increasing distance from the lenses 12. Since light dissipation can become an issue as distances increase from the light source, the increasing size of the double-lit area 22 in comparison to the decreasing size of the single-lit areas 30 and 32 provides a significant advantage in having a very well-lit reading area with an efficient use of the light generated by the LEDs 108 herein. Further, the fixed canting of the beams 136 and 138 allows a user to put on the glasses 5 and know that they will be able to begin reading even in dimly-lit areas by simply turning on the lights 16 without requiring that they be adjusted for focusing them on the material to be read.

[0023] The light mounts 18 are compactly sized housings 109 for containing the high intensity LEDs 108 and at least one, and preferably two, small disc-shaped battery power supplies 116 in a space savings manner therein. The housings 109 can be constructed of two halves or cover members 106 and 107 each with mounting surfaces generally designated 30 and 32 configured to orient the LED dome lens 34 in forward opening 36 of the housing 109 such that the light beam cones 136, 138 emanate in the desired inward direction. As best seen in Figs. 7,8 and 8A, the surfaces 30 and 32 can be formed integrally with their respective housing portions 106 and 107 such as on raised ribs 38 and 40. As shown, the surfaces 30 and 32 are each inclined to extend in the same direction relative to longitudinal axis 42 of the housing 109 such that they extend transversely and at an oblique angle thereto. In this manner, when the housing portions 106 and 107 are attached, the ribs 38 and 40 cooperate to capture the LED dome lens 34 in a canted orientation thereof relative to housing axis 42. Accordingly, with the LEDs 108 switched on, the axis 44 extending centrally through or bisecting the light beam cones 136 and 138 will generally extend parallel to the housing mounting surfaces 30 and 32 and at an oblique angle to the axis 42.

[0024] In the preferred and illustrated form, the eye-

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glasses 5 including temple arms 104 are constructed such that with the arms 104 opened, their forward end portions 104a will extend substantially normal to the general plane of the eyeglass lenses 12 and to any frame portions that may be included thereabout. Further, the housings 109 are constructed so that when attached flush to the arm forward end portion 104a as shown in Fig. 3, the housing axis 42 will extend parallel to the forward end portion 104a and straight forwardly from the glasses 5. With the preferred solid state material for the LEDs 108 as described hererinafter, they will generate a narrow light beam cone 136,138 of twenty degrees. For this narrow cone 136, 138, the oblique inward cant angle 46 is preferably approximately fifteen degrees so that the point 48 of intersection where the overlap lighted area 22 begins is centrally disposed between the lenses 12 and spaced forwardly therefrom approximately at the start of the reading distance range 24. This inward canting of the light beam cones 136 and 138 also minimizes the amount of light that is projected to lateral areas outside the field of view 26 forwardly of the glasses 5.

[0025] The LEDs 108 are preferably high-intensity white LED, such as manufactured by Chicago Miniature Lamp, Inc., of Hackensack, New Jersey, part number CMD333UWC-ND. Similar types of LEDs are available from a variety of manufacturers and such LEDs would also be acceptable for use in the light module 105. A particular advantage of using the described high-intensity LEDs is the ability of the LEDs to provide large amounts of bright light while consuming significantly less power than incandescent light sources and fiber optic devices. In particular, the LED 108 provides a typical 2300 mcd light output using only 20mA of power. This allows for significantly extended battery life using inexpensive and lightweight batteries. A further advantage of this type of LED is the relatively narrow viewing angle of approximately 20 degrees. This allows the light output to be directed in a very precise manner, making it ideally suited for use in the present invention. Referring in particular to Fig. 3, it can be seen that the angle of the LED 108 causes the cone of light to be emitted at a specific angle so that the light is directed slightly inward toward the portion being read and thereby avoiding scattering of light outwards and particularly outside the field of view of the glasses 5.

[0026] Turning now to Fig. 4, the light module 105 is shown in isolation from the eyeglasses. As can be seen in greater detail, the light module 105 houses a switch 114 having an actuator projecting portion 110. The projecting portion 110 is designed such that a user's thumb or finger can quickly and easily engage the projecting portion 110 to push the switch 114 for sliding in either one of two directions to turn the light module off and on. The elongated slot 112 is sized such that the switch 114 can be moved only a preset distance, thereby enabling the on and off functions to be accomplished with a minimum of motion. When the switch 114 is moved to the "on" position, a set of batteries 116 energize the LED 108. Similarly, when the switch 114 is moved to the "off" position, the connection between the batteries 116 and the LED 108 is broken and the LED 108 is turned off.

[0027] Referring to Fig. 5, an exploded perspective view of the light module 105 is shown. The light module 105 comprises a housing 109 that is preferably constructed of a lightweight material, such as plastic, to provide the greatest amount of comfort to the wearer, while still being a cost-effective product The housing 109 includes a first cover member 106 and a second cover member 107. The second cover member 107 is formed with a main flat wall 107a from which upstanding walls 107b extend from the periphery thereof to form an interior space 107c in which the switch 114, the batteries 116 and the LED 108 are disposed. The fastening devices 124, which may be self tapping screws among others, are used to fasten the first cover member 106 as a lid onto the second cover member 107.

[0028] The first cover member 106 is formed with an elongated slot 112 cut out of the main flat wall 106a, several integral projecting bosses 120 that can be internally threaded for receiving fastening members or screws 124 and an integral LED positioning member or raised rib 40. The LED positioning member 40 extends toward the cover 107 and has a concave surface 32 that cooperates with curved surface 30 of the cover member 107 for capturing the LED dome lens 34 at the desired angle 46 to axis 42 (Fig. 8a). As described above, the elongated slot 112 is designed to receive the projecting portion 110 of a switch 114 such that the projecting portion 110 extends slightly outside the first cover member 106 and is accessible by a user's finger or thumb. The cover member 106 also is formed having a slot 119 (Fig. 8) to form a housing for the switch 114 when the light module is fully assembled.

[0029] The LED 108 includes anode 111 and cathode 115 leads that are used to energize the LED 108. In addition, the anode 111 and cathode 115 leads are physically configured to also enable the LED 108 to be securely held in position within the light module 105. The cathode 115 lead, which is generally the shorter of the two leads, is trimmed further to a size suitable for engaging an aperture 113 in a box shaped member 130. The trimmed cathode 115 lead is bent into a curved hook configuration to behave as a resilient spring clip when mounted into the light module 105; and the anode lead is left in its original form and engages a second aperture in the box shaped member 130, which enables the anode 111 lead to extend into the open portion of the second cover member 107, as further discussed below.

[0030] The second cover member 107 includes a LED positioning member or rib 38 having curved surface 30 formed thereon for cooperating with surface 32 to capture the LED dome lens 34, as previously described. A lead guide assembly 130 is disposed within cover member 107. The guide assembly 130 channels or guides the anode 111 lead and the cathode 115 lead into their respective appropriate positions for conducting and switch-

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ing functions. The guide assembly 130 includes an extending sidewall 131 and an extending support structure 132. The support structure 132 includes first 133 and second 134 indents and a block 135 oriented between the first 133 and second 134 indents. When the LED 108 is placed into position in the guide assembly 130, the anode 111 lead is placed into the channel between the extending sidewall 131 and extending support structure 132. A large portion of the anode 111 lead extends beyond the sidewall 131 and into the cover member 107 opening. The cathode 115 lead, which is in a bent hook configuration is placed into the support structure 132 such that the portion of the cathode that is connected to the LED 108 is situated in the second 134 indent and the hooked portion engages the first 133 indent. The block 135 forces part of the cathode 115 lead to extend beyond the support structure 132 to enable contact between the batteries 116 and the cathode 115 via the switch 114.

[0031] The second cover member 107 also includes several apertures 122 for receiving the fastening devices 124. The fastening devices 124 are inserted into apertures 122 and engage the fastening receiving members 120 of cover member 106. The apertures 122 in the second cover member 107 are preferably countersunk such that the heads of the fastening devices 124 sit flush with the surface of the second cover member 107. Furthermore, by providing a standard phillips or slot headed fastening device, a user is able to gain access to the interior of the light module using a simply, commonly found household screwdriver. Once inside, the user self-services the light module 105 and, in particular, replaces the batteries 116 when they are exhausted.

[0032] The batteries 116, because of the low power consumption of the high-intensity LEDs 108, may be any commonly found small form factor batteries, such as three volt coin cells manufactured by Panasonic Corporation of Japan, part no. P189D. To this end, the disc-shaped batteries preferably have a diameter of slightly greater than three-fourths of an inch and a width of approximately one-eighth of an inch so that two batteries 116 can be stacked in a compact fashion. Accordingly, with the small LED 108 and the small and thin batteries 116, the housings 109 can be constructed in a very compact fashion. By way of example and not limitation, the main housing walls 106a and 107a have a maximum width of less than approximately one-inch. Since neither the batteries 116 or the LED 108 is particularly long, and the stroke of the switch 110 in minimized as previously described, the length of the housing 109 can be minimized to be on the order of approximately one and one-half inches. Finally, since the batteries 116 are so thin, the depth of the housing 109 can be sized to be slightly greater than the thickness of the two stacked disc batteries 116 or less than approximately one-half inch.

[0033] When assembled, the batteries 116 make contact with the anode or elongated portion 111 of the LED 108. The batteries 116 are stacked together such that the negative terminal of the first battery is an electrical contact with the positive terminal of the second battery. The positive terminal of the first battery 116 is then placed in electrical contact with the elongated portion 111 of the LED 18. The switch 114 which is constructed of an electrically conductive lightweight metal strip rests solely on the negative terminal of the second battery when the light module is not producing light, resulting in an open circuit When the switch 114 is placed in its "on" position, an electrical connection is created between the negative terminal of the battery 116 and the depending hooked portion 115 of the LED 108. Thus the circuit from the positive terminal of the battery 116 to the LED 108 is completed using the switch 114, and the LED 108 illuminates. The projecting portion 110 may be integrally formed as part of the metal strip or may be a plastic or metal projection that is fastened at an appropriate position in the body of the switch 114. The body of the switch 114 is constructed such that the metal strip includes one or more inclines formed by bends in the metal strip of the switch. The inclines are sized to cause the switch 114 to fit relatively sightly between the battery and the housing much like a spring, thereby enabling the switch to maintain its on or off position into which it has been placed.

[0034] Referring to Figs. 8 and 8A, the light module is shown in its assembled form. The LED positioning member 40 of the cover member 106 presses against the body of the LED 108 and pushed the LED 108 into a canted position within the housing 105. A particular advantage in such a configuration is that the LED is able to project light at a precise predetermined angle. Referring in particular to Fig. 8A, it can be clearly seen that the base 108a of the LED 108 helps to hold the LED 108 in place within the housing 105. Furthermore, it also clearly can be seen that the LED positioning member 40 is angled to a degree such that the top of the LED 108 is pushed against the second cover member 107 and particularly the positioning rib 38 thereof.

[0035] Turning now to Fig. 9, the eyeglasses 101 having the light modules 105 mounted thereon are shown in operation. The canted positioning of the LEDs 108 in each of the light modules 105 cooperate to create an overlapping zone 140 of their respective cones of light 136, 138 in the desired reading range. In particular, because of the twenty degree viewing angle of the LEDs 108, and their precise cant within the housing 107, the overlap area 140 occurs within a range of distances that is ideally suited for reading after the use of corrective lenses in the eyeglasses for those in need of vision correction. As a result, the incidence of stray light is reduced and the amount of light illuminating the reading surface is maximized, as previously described. The eyeglasses themselves may be of any configuration. For example, the lenses of the eyeglasses may or may not have frames surrounding the exterior edges of the lenses. Furthermore, the eyeglasses may have bridges for interconnecting the inner portions of the lenses of for interconnecting the inner portions of the lens frames, depending on whether the eyeglasses have frames.

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[0036] Referring to Figs. 10 and 11, the light module 105 is shown with a pair of spring clips 135 attached to the second cover member 107. The spring clips 135 may be manufactured of any strong resilient materials such as a high impact ABS plastic or metal, such as stainless steel. The spring clips 135 may be formed having slight ridges 135 to more securely hold the light modules 105 in place. The spring clips 135 enable the light module 105 to be retrofitted or removably attached to any eyeglasses. Therefore, the present invention is not limited to eyeglasses having premounted light modules that are more perfectly fixed to eyeglasses as by fasteners or the like requiring tools for their removal. Rather, any existing eyeglass frames maybe fitted with the light modules. Referring to Fig. 10, it can be seen that the spring clips 124 are fastened onto the housing 109 using the same apertures 120 and fastening devices 124 as described above. Therefore, a manufacturer of the light module obtains a cost benefit by using the same light module 105 platform, but easily configuring it in a number of different ways, depending on the type and configuration of the lighted eyeglasses.

[0037] Turning now to Figs. 12, 3, 4, and 15, a light module not according to the present invention is carried by clip-on glasses 142 having module mounts 145. Referring in particular to Fig. 12, the module mount 145 runs along the length of the light module 105 to provide stability and support to the light module 105. The module mount 145 is attached to the frame at the outer ends of the clip-on glasses and extends rearwardly therefrom. The light modules 105 are mounted on the light mounts 145 such that the respective LEDs 108 project light in a generally forward angled direction. As shown in greater detail in Fig. 13, the module mount 145, although running the entire length of the light module 105, is a relatively narrow strip. This ensures that the device remains light weight and retains its aesthetically pleasing design. As shown in Fig. 14, each of the light modules 105 is attached to a module mount in the temple area of the clip-on glasses 142 and is oriented such that the module mount can not be seen from the side. Fig. 15 shows a representative appearance of the clip-on glasses, having the light modules 105 mounted thereon, attached to a pair of standard eyeglasses 148.

[0038] Referring now to Figs. 16 and 17, a light module is shown having an integrally formed blinder extension 154 to eliminate glare. An advantage of such a light module is that reducing glare also reduces eye-fatigue that a wearer may suffer when wearing eyeglasses with the light modules for extended periods of use. Although both types of light modules work equally well, individuals with sensitive eyes may prefer the light module with the blinder extensions. By way of example only, and to illustrate the difference between the two light modules, eyeglasses are shown mounted with a first light module 150 with an integrally formed blinder extension 154 on one temple area of the eyeglasses and a second light module 105 (as generally described above) mounted on the other temple area of the eyeglasses.

[0039] Lighted eyeglasses having the light module 105, mounted in the manner described above may, in certain instances, create glare that is perceivable by the wearer. As shown, stray or incident light rays 170 that are emitted by the LED 108 may project towards the lens 156 of the pair of eyeglasses 158. The rays 170 are then reflected or refracted by the lenses 156 into the eyes of the wearer. In contrast, the glare reducing light module 150 includes an integral projecting portion or blinder extension 154 for reducing potential glare that may be generated as a result of the light 160 emitted by the LED 108 as it is reflected or refracted off the lenses 156 in the glasses 158. The light module 150 is comprised of a housing 162 that includes a first cover member 164 and a second cover member 166. The second cover member 166 includes the blinder extension 154, which is situated between the LED dome and the lens 156 when the light module is mounted to eyeglasses. The blinder extension 154 is configured such that it extends outwards in the direction of the LED 108 and is optimally sized such that the blinder extension 154 blocks the incident rays of light without distracting the wearer or interfering with the light 168 projected for illuminating a reading surface.

[0040] Similar to the clip-on glass frame 142, Figs. 18A, 18B and 19-23 are directed to another clip-on light apparatus 200. As shown, the apparatus 200 includes a frame 202 which spaces the lights along the length thereof. In this regard, the spacer frame 202 includes opposite ends or end portions 204 and 206 to which the lights 16 are mounted. The lights 16 can be provided in the illustrated light modules 150 including the compact housing 162 in which the LED 108 is oriented to project light forwardly so that as depicted in Fig. 9, the amount of light in the predetermined reading distance range 24 is maximized via large double lit area 140 therein with the frame 202 removably secured to the eyeglasses 208 and the lights turned on.

[0041] In the preferred and illustrated form, retainers 210 are provided at the frame end portions 204 and 206 that are configured to grip the lenses 212 and 214 of the eyeglasses 208. In particular, the frame 202 can include spacer rods, generally designated 216, that can be shifted along their length relative to each other to allow the frame 202 to adjust to differently sized eyeglasses 208, and specifically for eyeglasses that have different distances between the outer sides 212a and 214a of their respective lenses 212 and 214, at which the retainers 216 preferably grip the lenses 212 and 214, as shown in Fig. 18B.

[0042] For this purpose, the rods 216 are preferably incorporated in a draw spring assembly 218, as best seen in Figs. 19,21 and 23. The draw spring assembly 218 includes a coil extension spring 220. In the extended state of the spring 220, the frame end portions 204 and 206 are biased toward each other. To fit the adjustable frame 202 onto glasses 208, a user pulls one or both of the end portions 204 and 206 including the associated light mod-

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ules 150 in a direction away from each other as indicated by double-headed arrow 222 in Figs. 19 and 22. The pulling action compresses the coils 220a of the spring 220 as shown in Fig. 22 so that the frame 202 is spring loaded toward the Fig. 19 position where the end portions 204 and 206 are at their closest position relative to each other. With the retainers 210 aligned with the lens sides 212a and 214a, the user then allows the end portions 204 and 206 to shift back toward each other under the influence of the spring bias afforded by the compressed spring 220 of the draw spring assembly 218.

[0043] As the coils expand, the aligned retainers 210 shift toward each other to grip onto the lens sides 212a and 214a. In this manner, the retainers 210 are spring loaded into secure gripping engagement with the lenses 212 and 214. The retainers 210 at the opposite end portions 210 and 214 are generally spaced at approximately same or slightly greater distance than the distance between the outer lens sides 212a and 214a of the glasses 208 when they are removably attached thereto, as can be seen in Fig. 18B.

[0044] To resist fore and aft shifting of the clip-on frame 202, the retainers 210 preferably have a generally U-shaped configuration including forward and rearward legs 224 and 226, respectively. The lens sides 212a and 214a fit into the space 228 between the small retainer legs 224 and 226 so that the forward legs 224 extend around the front 212b and 214b of the lenses 212 and 214, and the rearward legs 226 extend around the rear 212c and 214c of the lenses 212 and 214. For providing additional stability, a pair of vertically spaced upper and lower retainer members 210 can be provided at either end portion 204 and 206, as best seen in Fig. 20. The upper and lower retainer members 210 grip the lens sides 212a and 214a along their height so that they are above and below each other. By having the vertically spaced retainers 210, pivoting of the apparatus 200 as releasably attached to the eyeglasses 208 such as about a plane defined between a pair of opposite retainers 210 is likewise resisted.

[0045] The retainers 210 are mounted to flange arms 230 at inner end portions 230a thereof. The arms 230 are preferably malleable so that the precise position of the retainers 210 can be adjusted for fitting securely against various configurations of lenses 212 and 214, and particularly the outer sides 212a and 214a thereof. For this purpose, the arms 230 are formed of thin wire stock that can be slightly bent such as to bring the upper and lower retainers 210 closer together or further apart depending on the height and configuration of the lens sides 212a and 214a.

[0046] Turning to more of the details of the illustrated clip-on light apparatus 200, the arm end portions 224a can be provided with a U-shaped configuration to form a portion of the retainer members 210 that is integral with the arms 230. To improve the frictional engagement of the retainers 210 with the hard material, e.g. metal, glass or hard plastic, of the lenses outer sides 212a and 214a, a small resilient plastic sleeve 232 is fit tightly over the U-shaped arm ends 230a. The sleeve 232 also avoids damaging the eyeglass lenses 212 and 214 with the retainers 210 spring-loaded thereagainst

[0047] As best seen in Figs. 21 and 22, the arms 230 can extend rearwardly from their inner end retainer portions 230a also generally in a U-shape configuration opening forwardly so that they have an inner leg 234 connected to the retainer portion 230a and an outer leg 236 connected to the light module 150. More specifically, mounting plate 238 is fastened to the housing cover member 166, as shown in Fig. 23. The outer leg 236 of the mounting arms 230 extends transversely across the plate 238 and is welded or otherwise attached thereto. In the double or paired retainer configuration where two vertically spaced retainers 210 are employed at each end portion 204 and 206 of the light module spacer frame 202, the arms 230 can be formed from a single piece of wire so that there is a vertical wire portion 240 that interconnects the forward ends of the upper and lower outer legs 236 and which can likewise be welded to the plate 238 along the length thereof.

[0048] With respect to the frame 202, it can be formed of slightly thicker wire stock vis-a-vis that used for the malleable mounting arms 230 so that the frame 202 is of rigid construction. In the illustrated and preferred form, the spacer frame 202 includes opposite vertical wire portions 242 and 244 welded or otherwise attached to the mounting plates 238 adjacent to and forwardly of the wire portion 240 that interconnects the retainer arms 230, as previously described. The wire portions 242 and 244 project beyond the top side of the modules 150 so that the draw spring assembly 218 is disposed above the eyeglass lenses 212 and 214 when the clip-on light apparatus 200 is releasably secured thereto, as can be seen in Fig. 18B.

[0049] The wire portions 242 and 244 are bent above the modules 150 generally at right angles to extend toward each other. Referring to Fig. 19, a horizontal wire portion or rod 246 extends perpendicular from wire portion 242 and through the barrel formed by the coils 220a of the coil spring 220. A pair of horizontal wire portions or rods 246 extend perpendicular from wire portion 244 on either side of the spring 220 so that the rod 246 extends between the rods 248.

[0050] The coil spring 220 is disposed between slide members 250 and 252 that ride on respective rods 248 and 246 for adjusting the length of the frame 202. The slide member 250 is fixedly connected toward distal end 246a of the rod 246 and the slide member 252 is fixedly connected at the distal ends of the rods 248. The slide member 250 extends transversely to span the rods 248 on either side thereof and has a pair of apertures 254 (Fig. 23) sized in clearance fit with the rods 248 so that the slide or plate member 250 can ride therealong. Similarly, the slide or plate member 252 is apertured for riding along the centrally extending rod 246.

[0051] The coil spring 220 normally biases the plate

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members 250 and 252 apart bringing the frame end portions 204 and 206 toward each other. Referring to Figs. 19 and 21, a stop 256 is formed between yoke juncture 258 of the rods 248 and the projecting rod end 246a that extends beyond slide plate 250 fixed thereto to limit the axial expansion of the spring 220, thus defining the closest axial position of the end portions 204 and 206 and opposite light modules 150. With the rod end 246a engaged against the yoke portion 258, the rods 246 and 248 have their greatest degree of overlap and can no longer be shifted in an inward direction toward each other. As such, with the stop 256 operable, the coils 220a of the spring 220 are at their maximum extended state.

[0052] Adjusting the length of the frame 202 by pulling either or both of the frame end portions 204 and 206 in the axial direction 222 causes the opposite plates 250 and 252 to slide toward each other axially compressing the spring 220 and coils 220a thereof therebetween with rod end 246a separating from the yoke portion 258, as shown in Fig. 22. In this manner, the draw spring assembly 218 provides a return force via the compressed spring to bias the retainers 210 at the opposite end portions 204 and 206 back toward each other and into secure engagement with the eyeglasses 208 properly positioned therebetween. Once the coil spring 220 is fully compressed between the plate member 250 and 252, i.e. the adjacent spring coils 220a are engaged without intervening gaps, the maximum length of the frame 202 has been reached thus substantially defining the largest size of eyeglasses 208 as measured between the lenses outer sides 212a and 214a to which the apparatus 200 can be releasably attached or dipped.

[0053] With the apparatus 200 releasably secured to the eyeglasses 208, the preferred light modules 150 will be positioned in a manner akin to that as provided on the previously-described lighted eyeglasses 5. Referring to Figs. 18B and 23, it can be seen that the retainers 210 are disposed toward the forward end of the housing 162 so that the housing 162 will extend adjacent to and rearwardly along the forward portions of the eyeglass temple arms 260 for the majority of the housing length. The forward end of the housing 162 will generally be aligned with the lens front sides 212b and 214b depending on their thickness and degree of curvature. In this manner, the reader will be able to obtain the same benefits as provided by the lighted eyeglasses 5 in terms of having the maximum amount of light trained onto the reading area, while also minimizing glare during reading via the blinder extensions 154 disposed between the LED dome lens 34 projecting out forwardly from the housing 162 and the adjacent eyeglass lenses 212 and 214. At the same time, when lights for reading are not needed, the apparatus 200 can be easily removed to reduce the weight for maximum comfort when wearing the eyeglasses 208.

[0054] Figs. 24-26 illustrate another alterative clip-on light apparatus 300. In this version, the apparatus 300 includes an elongate spacer frame 302 having opposite ends 304 and 306 to which the lights 16 are mounted, which again can be provided in the previously-described light modules 150. However, unlike the apparatus 200 and specifically the spacer frame 202 thereof, the frame 302 is not adjustable in length and thus can be in the form of a single rod 308 having transverse mounting plates 310 and 312 at either frame end 304 and 306 for fastening of the light modules 150 thereto.

[0055] To releasably secure the apparatus 300 to the eyeglasses 208, a clipping mechanism 314 is provided intermediate the frame ends 304 and 306 and preferably centrally therebetween to allow the apparatus 300 to be clipped in the area that is generally disposed between the lenses 212 and 214, this area including inner portions 212a and 214a of the respective lenses and the nose bridge 209 extending therebetween. More particularly, the clipping mechanism 314 has spring-loaded arm pairs 316 and 318 that clamp onto the inner lens portions 212a and 214a or the frame portions thereat to minimize interference with the field of view provided through the lenses 212 and 214. An actuator lever 320 is operable to pivot the arm pairs open for securing the apparatus 300 to or removing the apparatus 300 from the eyeglasses 208. With the apparatus 300 releasably clipped onto the eyeglasses 208, the actuator 320 will generally be disposed above the bridge portion 209 of the glasses 208, as can be seen in Fig. 24.

[0056] The lever 320 is integrally connected with pivotal clamp arms 322 and 324 of the arm pairs 316 and 318 with the other arms 326 and 328 being fixed relative thereto and integrally formed with base 329 of the clipping mechanism 314. Torsion springs 330 and 332 are attached between the lever 320 and an upstanding wall portion 329a of base 329 to bias the arms 322 and 324 toward associated arms 326 and 328 for clamping the lens potions 212a and 214a therebetween. To open the arm pairs 316 and 318, the lever actuator 320 is pushed against the spring bias provided by springs 330 and 332 to pivot it along with transverse shaft portions 334 and 336 formed integrally between the lever 320 and the arms 322 and 324, respectively, in the direction indicated by arrow 338 in Fig. 26. This pivoting causes pivoting of the integral arms 322 and 324 away from associated arms 326 and 328 in the direction indicated by arrow 340 to separate the ends of the arms 322 and 326 and the arms 324 and 328 from each other allowing the apparatus 300 to be either removed form or secured onto the eyeglasses 208.

[0057] As shown in Fig. 26, the rod 308 is captured in a recess 342 formed in the base wall portion 329a by ends of the springs 330 and 332. In this manner, the rod 308 can be rotated about its axis 308a to allow a user to direct the light emanating from the modules 150 to their preferences. The rod 308 can include enlarged stops formed thereon laterally spaced to be disposed on either side of the base 329 and specifically the wall portion 329a to limit axial or longitudinal shifting of the rod 308 relative to the clipping mechanism 314.

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[0058] While there have been illustrated and described particular embodiments of the present invention, it will be appreciated that numerous changes and modifications will occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications that fall within the scope of the present invention.

Claims

1. Lighted eyewear (10) comprising:

   a pair of lenses (12);
   a pair of temple arms (104) that extend rearwardly from respective outer portions of the lenses (12) wherein the temple arms (104) can be opened for use and folded when not in use;
   characterised by:

   light emitting diodes (LEDs) (108) mounted in housings (162) configured to fix beams of light to be directed inward toward each other so that the beams overlap in a reading distance range;
   wherein the housings (162) are fixed to the temple arms (104) toward the forward ends thereof, and with the temple arms (104) opened, the housings (162) are each oriented to project light therefrom forwardly, inwardly and toward the light emanating from the housing (162) fixed on the other arm (104);
   wherein the housings (162) include blinder extensions (154) that respectively project between the LEDs (108) and adjacent ones of the lenses (12) to minimise refraction or reflection of light emanating from the LEDs (108) through the lenses (12); and
   wherein the housings (162) include at least one disc-shaped battery power supply (116) for the light emitting diodes (108) to allow the housing (162) to be compactly sized with each of the light emitting diodes (108) and the battery power supply (116) therefor self-contained in respective ones of the housings (162).

2. The lighted eyewear of claim 1, wherein each blinder extension comprises an integral portion of the housing.

3. The lighted eyewear of claim 1 or 2, wherein the lenses are configured to be either refractive or non-refractive.

4. Lighted eyewear according to claim 1, 2 or 3, wherein the housings have opposite ends and a housing axis extending between the ends, the LEDs at one of the ends of the housings, and
   the blinder extensions extending alongside the LEDs at the one end of the housings for minimizing glare from the light projected from the LEDs, and thereby reducing eye-fatigue that the wearer of the eyewear may suffer.

5. The eyewear of claim 4, wherein the LEDs are each configured to project light in a cone having an axis that is canted to extend transversely to the housing axis, and the blinder extensions extend generally parallel to the housing axis in position to block incident or stray light from the LEDs.

6. The eyewear of any one of the preceding claims, wherein
   the housings have an opening at the one end in which a portion of the LEDs is disposed, and the blinder extensions extend from the openings away from the housings.

7. The eyewear of any one or the preceding claims, wherein
   the housings have side walls, and the blinder extensions are a portion of one of the side walls extending axially beyond the other side wall at the one end of the housing.

8. The eyewear of any one of the preceding claims, wherein the LEDs have a lens, and the blinder extensions extend alongside the LED lenses.

9. The eyewear of claim 8, wherein the housings have an opening at the one end with the LED lens disposed therein and projecting out therefrom.

10. The eyewear of any one of the preceding claims and including switches operable to selectively provide power from the power sources to the LEDs.

11. The eyewear of any one of the preceding claims, wherein
    the housings are compactly-sized, self-contained lighting modules for the glasses, and wherein the lighting modules are attached to the eyewear removably.

Patentansprüche

1. Leuchtende Brille (10) umfassend:

   ein paar Linsen (12);
   ein paar Bügelarme (104), die sich von jeweils äußeren Abschnitten der Linsen (12) nach hinten erstrecken, wobei die Bügelarme (104) zur Verwendung geöffnet und bei Nicht-Verwen-

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dung gefaltet werden können;
gekennzeichnet durch:

Leuchtdioden (LEDs) (108), die in Gehäusen (162) montiert sind, die dazu ausgestaltet sind, Lichtstrahlen, die aufeinander zu nach innen zu richten sind, zu befestigen, so dass die Strahlen in einem Leseabstandsbereich überlappen;
wobei die Gehäuse (162) an den Bügelarmen (104) in Richtung von deren frontseitigen Enden befestigt sind und, wenn die Bügelarme (104) geöffnet sind, die Gehäuse (162) so ausgerichtet sind, dass sie Licht von sich nach vorne, nach innen und in Richtung des Lichtes projizieren, das von dem Gehäuse (162), das an dem anderen Arm (104) befestigt ist, ausgeht;
wobei die Gehäuse (162) Abschattungsverlängerungen (154) umfassen, die jeweils zwischen den LEDs (108) und benachbarten der Linsen (12) vorstehen, um Brechung oder Reflexion von Licht, das von den LEDs (108) **durch** die Linsen (12) ausgeht, zu minimieren; und
wobei die Gehäuse (162) zumindest eine scheibenförmige Batteriestromzufuhr (116) für die Leuchtdioden (108) umfassen, damit das Gehäuse (162) kompakt bemessen sein kann, wobei jede der Leuchtdioden (108) und der Batteriestromzufuhr (116) hierfür in jeweils einem der Gehäuse (162) abgeschlossen ist.

2. Leuchtende Brille nach Anspruch 1, wobei jede Abschattungsverlängerung einen integralen Abschnitt des Gehäuses umfasst.

3. Leuchtende Brille nach Anspruch 1 oder 2, wobei die Linsen entweder brechend oder nicht brechend ausgestaltet sind.

4. Leuchtende Brille nach Anspruch 1, 2 oder 3, wobei

die Gehäuse gegenüberliegende Enden und eine Gehäuseachse haben, die sich zwischen den Enden erstreckt, wobei die LEDs an einem der Enden der Gehäuse sind, und
die Abschattungsverlängerungen sich längsseits der LEDs an dem einen Ende der Gehäuse erstrecken, um ein Blenden durch das Licht, das von den LEDs projiziert wird, zu minimieren und dadurch eine Ermüdung der Augen, die der Träger der Brille erleiden kann, zu reduzieren.

5. Brille nach Anspruch 4, wobei die LEDs jeweils dazu ausgestaltet sind, Licht in einem Kegel zu projizieren, der eine Achse aufweist, die geneigt ist, so dass sie sich quer zur Gehäuseachse erstreckt, und die Abschattungsverlängerungen sich allgemein parallel zu der Gehäuseachse in einer Position erstrecken, um einfallendes oder gestreutes Licht von den LEDs zu blockieren.

6. Brille nach einem der vorhergehenden Ansprüche, wobei die Gehäuse eine Öffnung an dem einen Ende aufweisen, in dem ein Abschnitt der LEDs angeordnet ist, und die Abschattungsverlängerungen sich von den Öffnungen von den Gehäusen weg erstrecken.

7. Brille nach einem der vorhergehenden Ansprüche, wobei die Gehäuse Seitenwände aufweisen und die Abschattungsverlängerungen ein Abschnitt einer der Seitenwände sind, die sich axial über die andere Seitenwand an dem einen Ende des Gehäuses hinaus erstreckt.

8. Brille nach einem der vorhergehenden Ansprüche, wobei die LEDs eine Linse aufweisen und die Abschattungsverlängerungen sich längsseits der LED Linsen erstrecken.

9. Brille nach Anspruch 8, wobei die Gehäuse eine Öffnung an dem einen Ende aufweisen, wobei die LED Linse darin angeordnet und davon vorstehend ausgebildet ist.

10. Brille nach einem der vorhergehenden Ansprüche und umfassend Schalter, die dazu betätigt werden können, wahlweise Strom der Stromquellen zu den LEDs zuzuführen.

11. Brille nach einem der vorhergehenden Ansprüche, wobei die Gehäuse kompakt bemessene, eigenständige Beleuchtungsmodule für die Brille sind und wobei die Beleuchtungsmodule abnehmbar an der Brille angebracht sind.

Revendications

1. Lunettes éclairantes (10) comprenant :

une paire de lentilles (12) ;
une paire de branches (104) qui s'étendent vers l'arrière à partir de parties extérieures respectives des lentilles (12) où les branches (104) peuvent être ouvertes en cas d'utilisation et pliées en cas de non-utilisation ;
caractérisées par :

des diodes électroluminescentes (LED) (108) montées dans des coffrets (162) configurées pour fixer des faisceaux de lumière pour être dirigés vers l'intérieur l'une de

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l'autre de sorte que les faisceaux se chevauchent dans une plage de distance de lecture ;
où les coffrets (162) sont fixés aux branches (104) vers leurs extrémités avant, et avec les branches (104) ouvertes, les coffrets (162) sont orientés chacun pour projeter de la lumière de ceux-ci vers l'avant, vers l'intérieur et vers la lumière émanant du coffret (162) fixé sur l'autre branche (104) ;
où les coffrets (162) comportent des extensions de liaison (154) qui se projettent respectivement entre les LED (108) et des lentilles adjacentes parmi les lentilles (12) pour minimiser la réfraction ou la réflexion de la lumière émanant des LED (108) à travers les lentilles (12) ; et
où les coffrets (162) comportent au moins un bloc d'alimentation à pile (116) en forme de disque pour les diodes électroluminescentes (108) pour permettre d'avoir un coffret (162) d'une conception compacte, chacun des diodes électroluminescentes (108) et du bloc d'alimentation à pile associé (116) pouvant tenir dans des coffrets respectifs (162).

2. Lunettes éclairantes de la revendication 1, où chaque extension de liaison comprend une partie intégrante du coffret.

3. Lunettes éclairantes de la revendication 1 ou 2, où les lentilles sont configurées pour être réfractive ou non réfractive.

4. Lunettes éclairantes de la revendication 1, 2 ou 3, où les coffrets ont des extrémités opposées et un axe de coffret s'étendant entre les extrémités, les LED étant au niveau d'une première extrémité des extrémités des coffrets, et
les extensions de liaison s'étendant le long des LED au niveau de la première extrémité des coffrets pour minimiser le reflet de la lumière projetée depuis les LED, et ainsi réduire la fatigue oculaire que le porteur des lunettes peut en souffrir.

5. Lunettes de la revendication 4, où les LED sont configurées chacune pour projeter de la lumière dans un cône ayant un axe qui est incliné pour s'étendre transversalement par rapport à l'axe de coffret, et les extensions de liaison s'étendent de manière globalement parallèle à l'axe de coffret en position pour bloquer la lumière parasite ou incidente provenant des LED.

6. Lunettes de l'une quelconque des revendications précédentes, où les coffrets ont une ouverture au niveau de la première extrémité dans laquelle une partie des LED est disposée, et les extensions de liaison s'étendent depuis les ouvertures loin des coffrets.

7. Lunettes de l'une quelconque des revendications précédentes, où les coffrets ont des parois latérales, et les extensions de liaison représentent une partie de l'une des parois latérales s'étendant axialement au-delà de l'autre paroi latérale au niveau de la première extrémité du coffret.

8. Lunettes de l'une quelconque des revendications précédentes, où les LED ont une lentille, et les extensions de liaison s'étendent le long des lentilles de LED.

9. Lunettes de la revendication 8, où les coffrets ont une ouverture au niveau de la première extrémité à l'intérieur de laquelle la lentille de LED est disposée et depuis laquelle elle se projette.

10. Lunettes de l'une quelconque des revendications précédentes et comportant des commutateurs pouvant fonctionner pour fournir sélectivement de la puissance depuis des sources d'alimentation aux LED.

11. Lunettes de l'une quelconque des revendications précédentes, où les coffrets sont des modules d'éclairage autonomes, de conception compacte pour les lunettes, et où les modules d'éclairage sont attachés de manière amovible aux lunettes.

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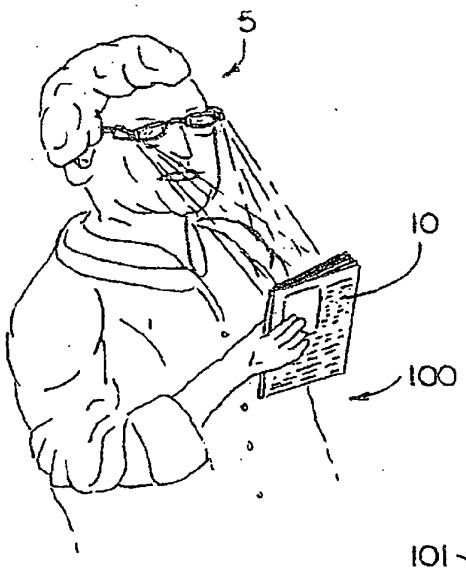

FIG. 1

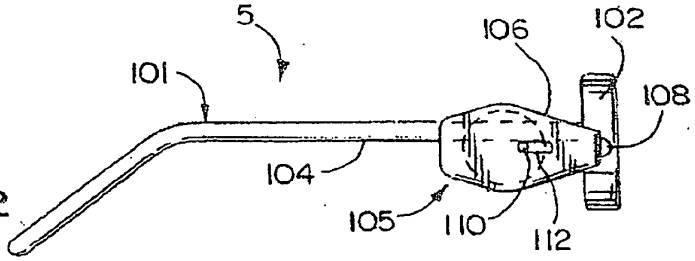

FIG. 2

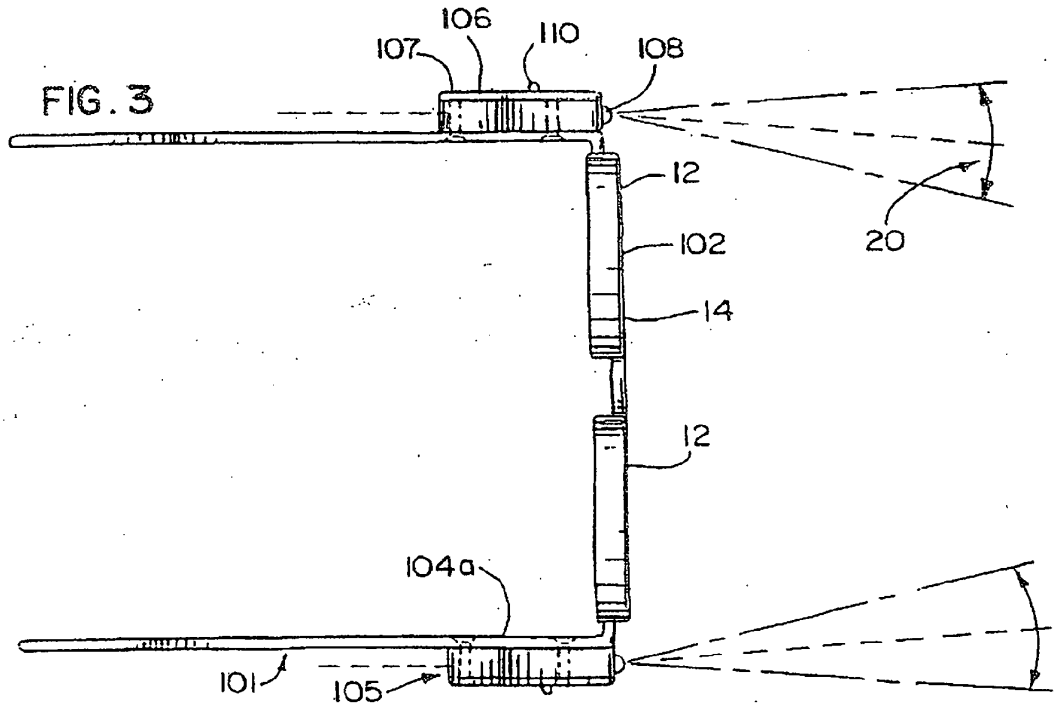

FIG. 3

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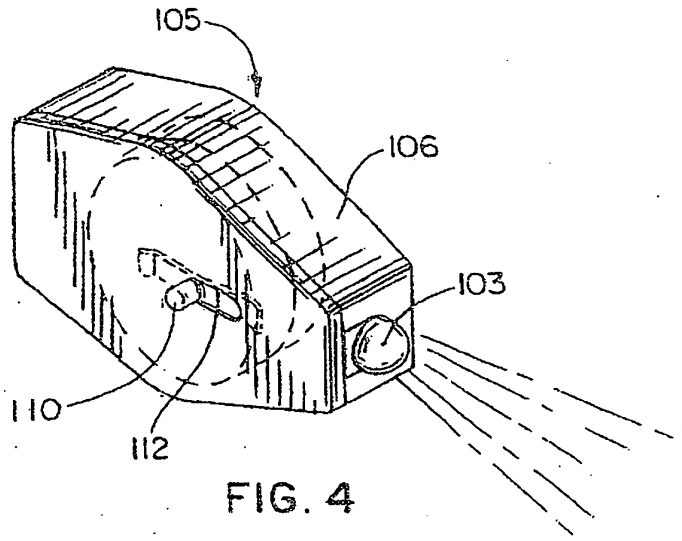

FIG. 4

FIG. 5

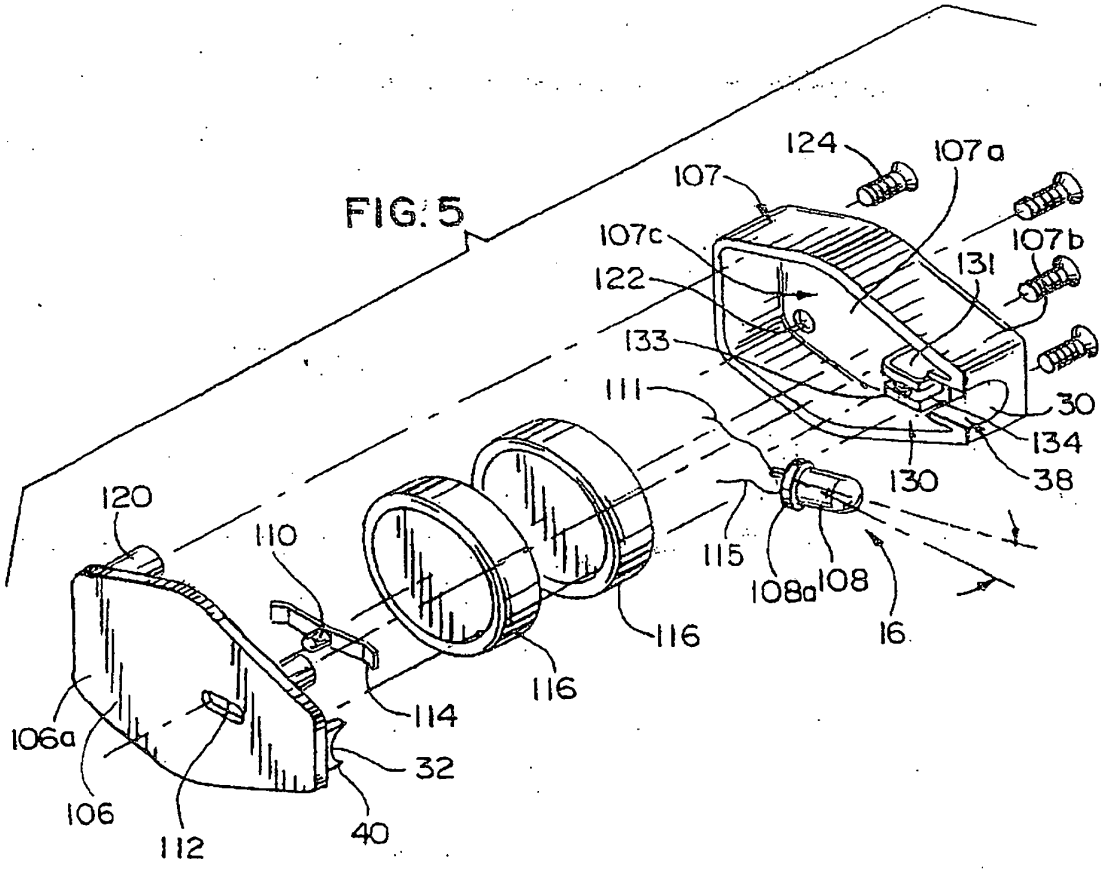

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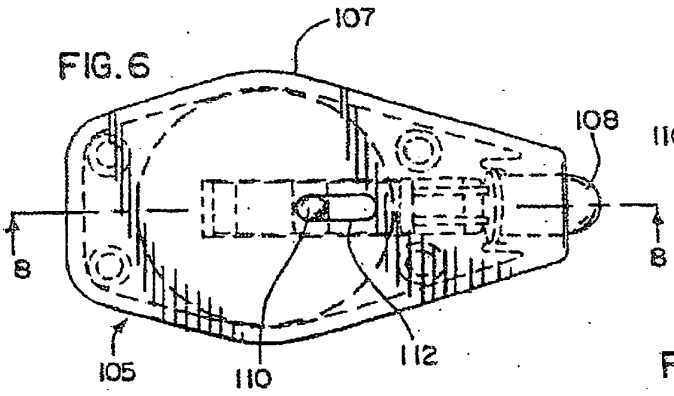
FIG. 6



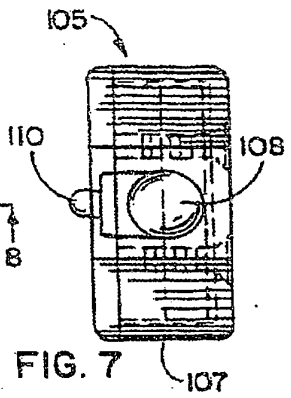


FIG. 7

FIG. 8

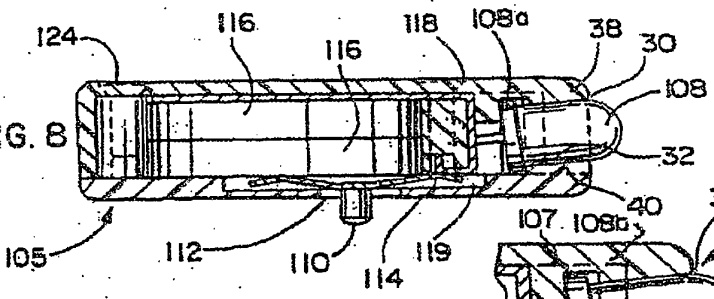


FIG. 8A

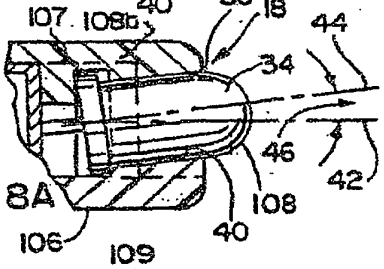


FIG. 10

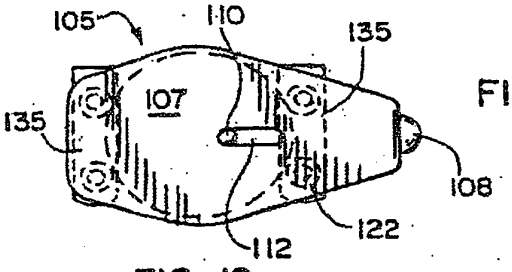
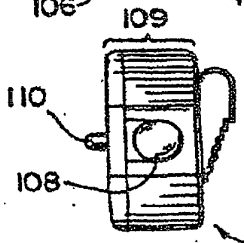


FIG. 11



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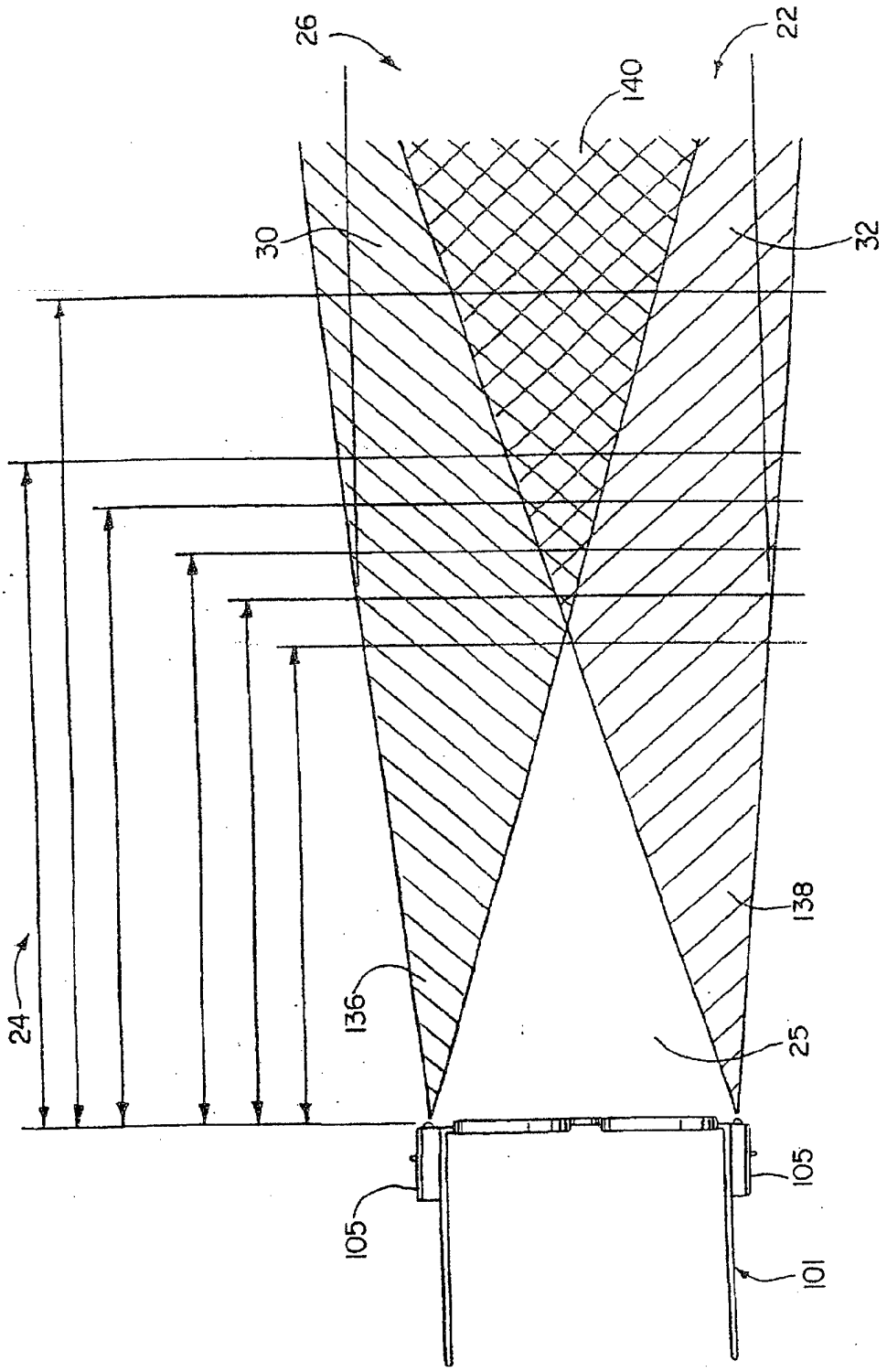

FIG. 9

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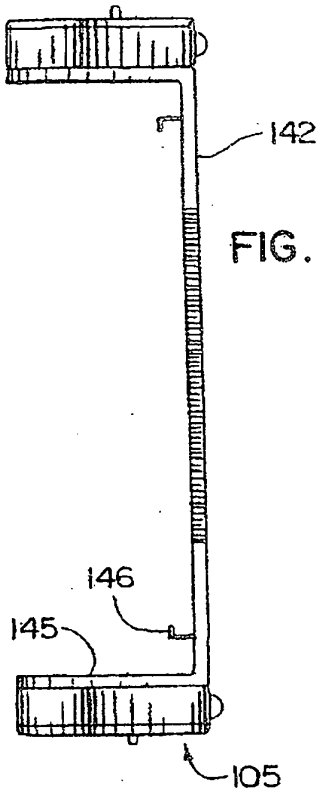

FIG. 12

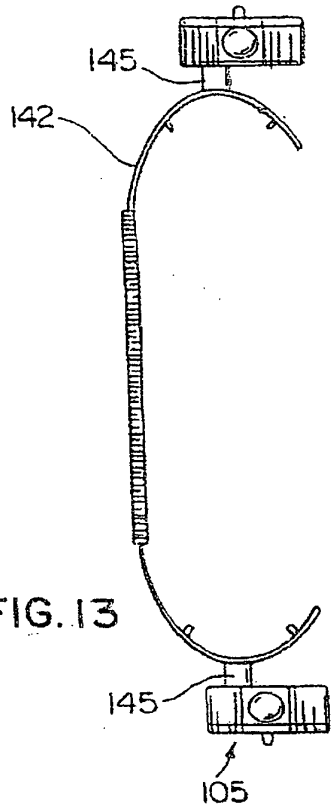

FIG. 13

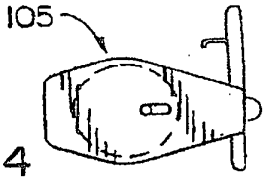

FIG. 14

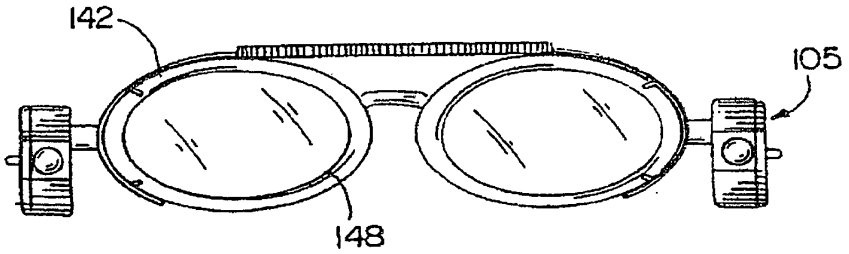

FIG. 15

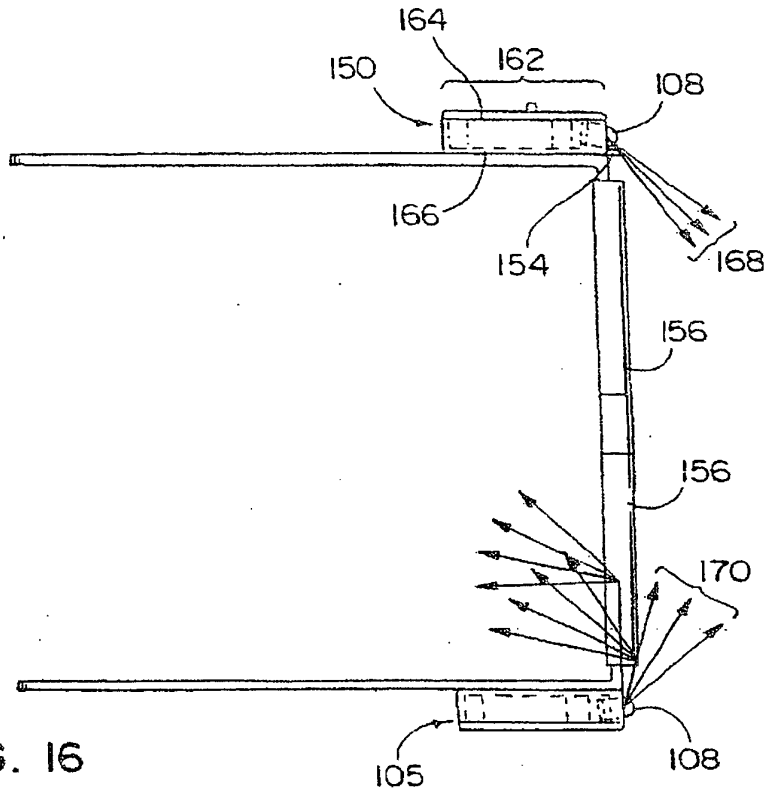

FIG. 16

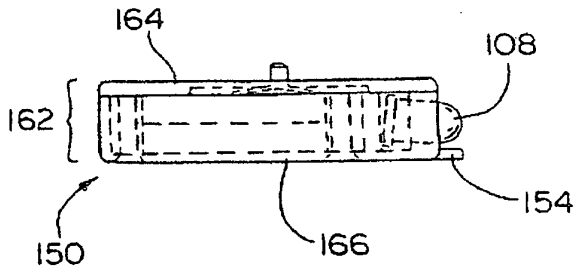

FIG. 17

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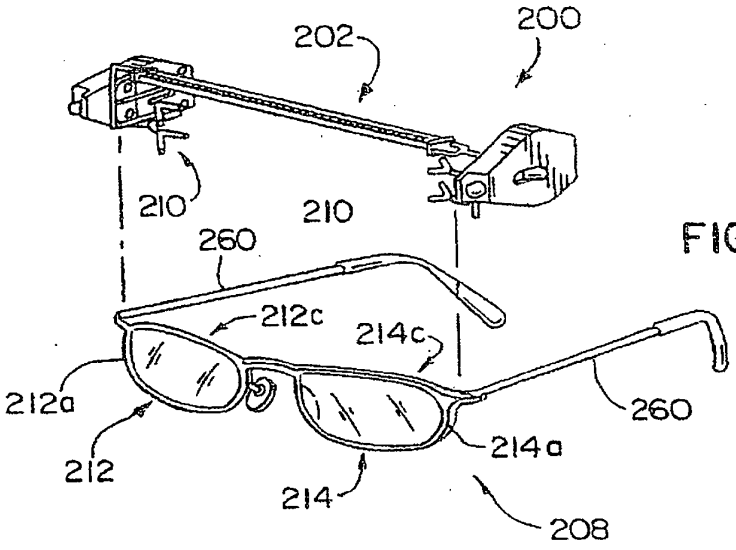

FIG. 18A

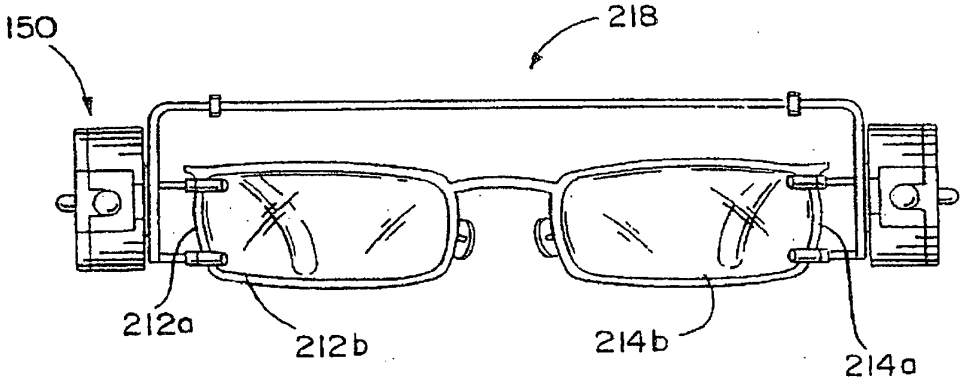

FIG. 18B

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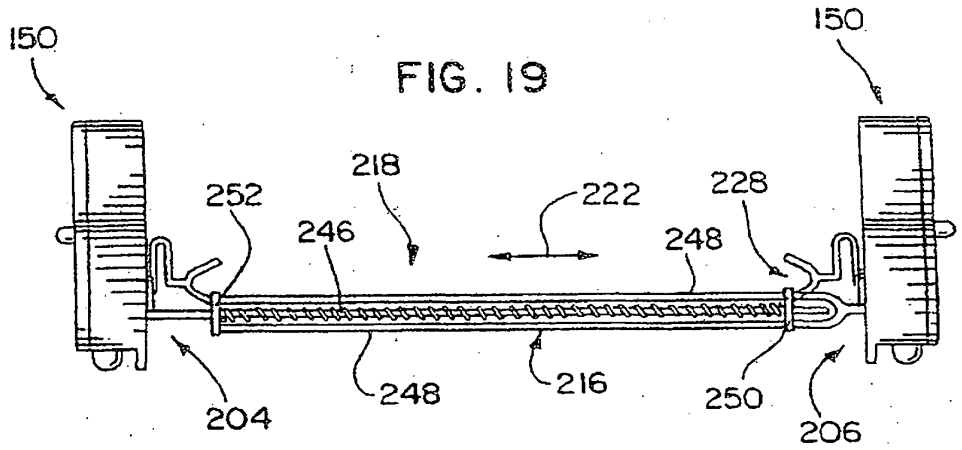
FIG. 19



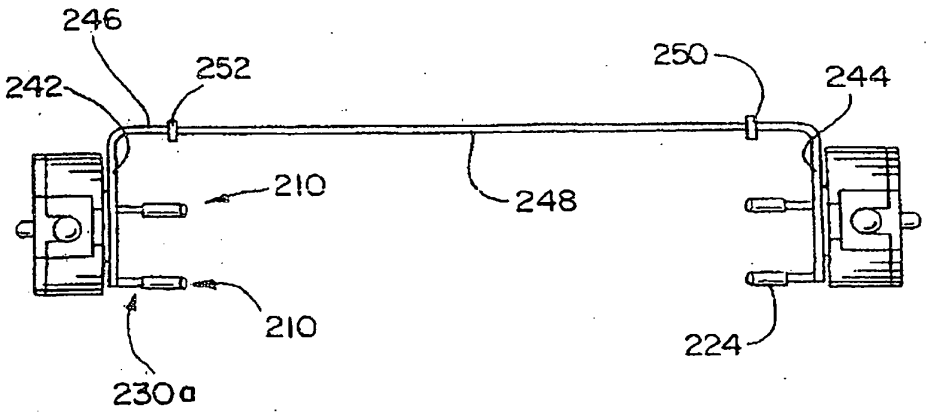


FIG. 20

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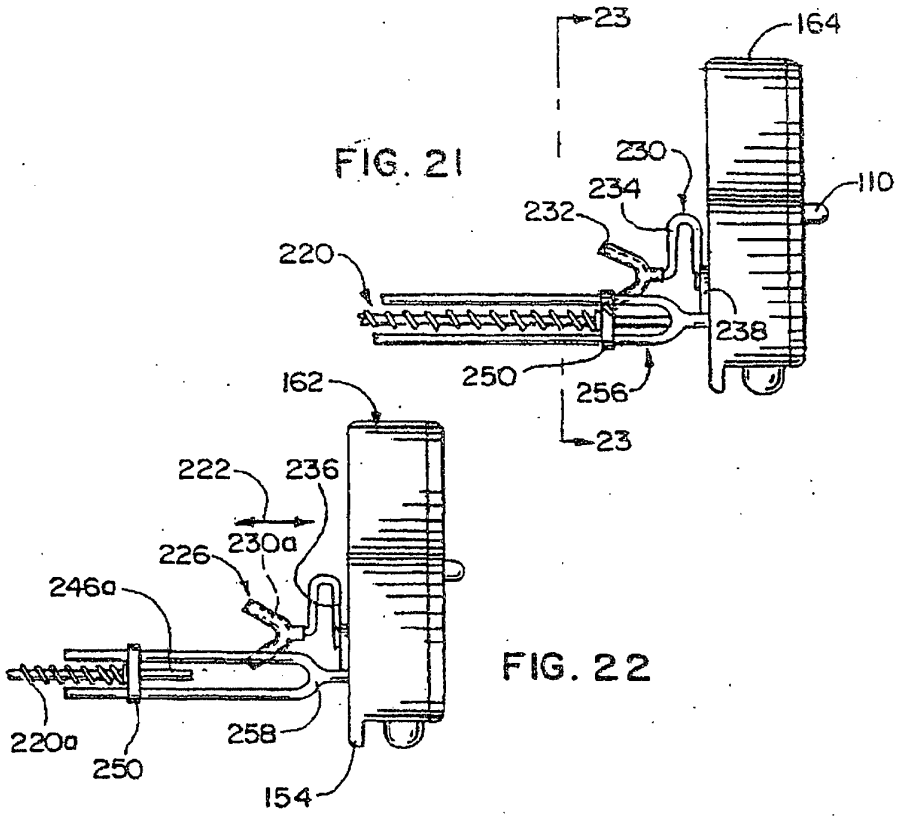

FIG. 21

FIG. 22

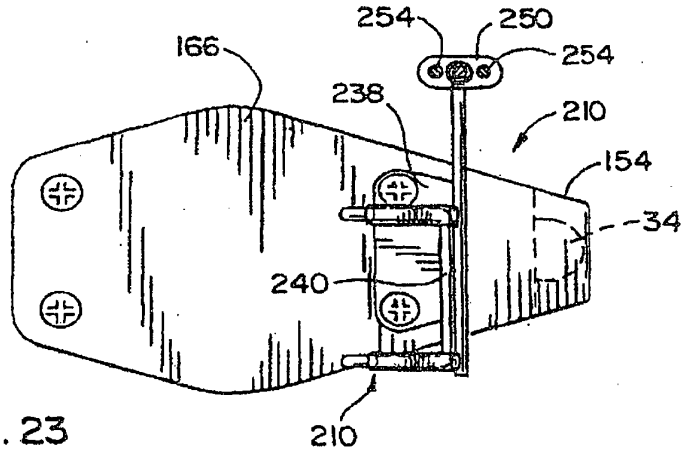

FIG. 23

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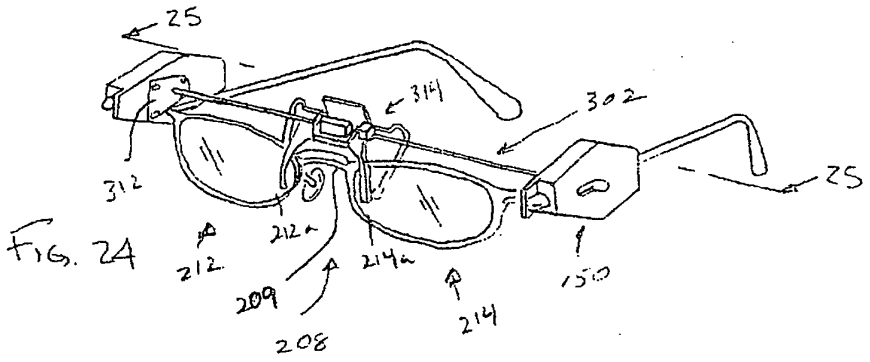

FIG. 24

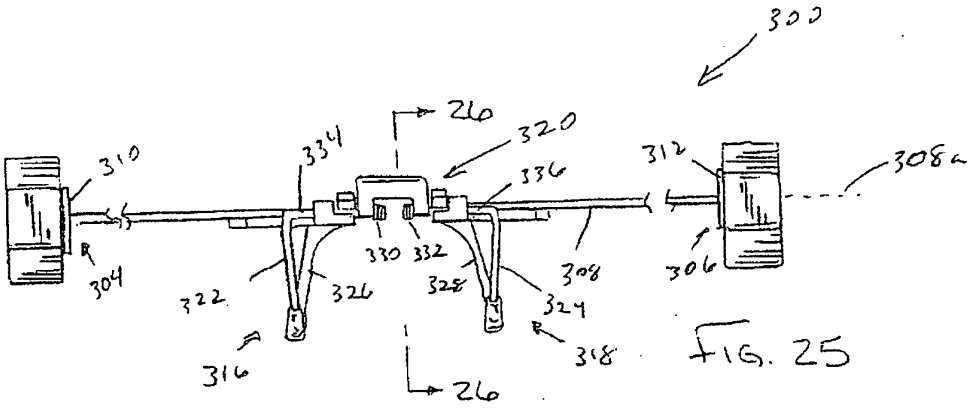

FIG. 25

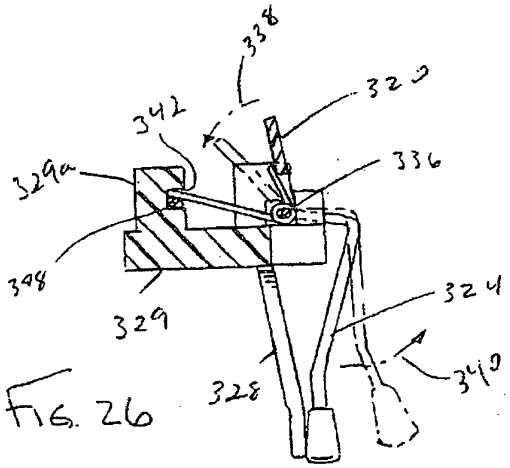

FIG. 26

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 94108862 U1 **[0009]**
- US 4959760 A **[0009]**

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Dual mode receiver for receiving satellite signal and terrestrial signal in digital broadcasting system

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CPCA	H04H40/90	2013-01-01

Abstract

SUMMARY A dual mode receiver for receiving a QPSK modulated satellite signal and a multi-carrier modulated (MCM) terrestrial signal is provided. The dual-mode receiver has a complex architecture that includes a minimum number of filters selected to facilitate both QPSK and MCM demodulation.

Description

DETAILED DESCRIPTION OF THE INVENTION
BACKGROUND OF THE INVENTION The present invention relates to a receiver for use in a digital broadcasting system having a combined architecture for receiving both satellite and terrestrial signals, such as the proposed Digital Voice over Radio Service (DARS). .
[0002] US-A-5,600,672 relates to a communication system capable of extracting first and second data streams from a received signal of a receiving side. One of the data streams can be selected for further processing, including analog-to-digital conversion, filtering, carrier recovery, phase synchronization, and

decoding.
[0003] US-A-4,355,401 discloses a radio device having a receiving unit for receiving an analog signal and a digitally modulated carrier wave signal. First and second demodulators for demodulating analog and digital signals, respectively, are provided. The determination circuit determines whether the received signal is an analog FM wave or a digital FM wave in response to the output of the clock recovery circuit. Depending on the decision, the demodulated analog signal or the demodulated digital signal is selectively carried by the switching means.
[0004] EP-A-0574273 shows a receiver having an AM-FM combined demodulator. The receiver has a common oscillator and a mixer circuit. When the analog modulated signal is received, the frequencies of the common oscillator and the local oscillator of the mixer circuit are controlled using a frequency error detector. The receiver further includes a modulator in which a demodulator for an analog modulation signal and a demodulator for a digital modulation signal are connected in parallel. A digital modulation signal discriminator is connected to the digital modulation signal demodulator, and switches the receiver to an appropriate demodulation mode.
[0005] EP-A-0 769 873 describes a modulation signal such as quadrature amplitude modulation and a vestigial sideband R
An RF receiver adapted to receive one or more F input signals or the like. The RF signal is passband filtered, downconverted using three bandpass filters and two mixers, and the output of the third bandpass filter is applied to a sample and hold circuit. The output of the sample and hold circuit is coupled to an analog-to-digital converter via a low-pass filter, whose output is
It is applied to a Hilbert filter that demodulates the sampled signal and generates a baseband signal.
[0006] Groshong R. et. Al., "Undersampling Techniques Simplify Digital Radio", Electronic Desi
gn (Electronic Design), Vol. 39, No. 10, May 23, 1991, Nos. 67-68,
On pages 70, 73-75, 78, a broadband input filter, a first IF mixer,
A typical heterodyne receiver comprising a first IF narrowband filter, a second IF mixer having a fixed oscillation frequency, a second selectable IF filter, and separate demodulators for AM and FM. Machine is listed.
SUMMARY OF THE INVENTION It is an object of the present invention to provide an apparatus and method for receiving broadcast signals, which enables reception of satellite signals and terrestrial signals using a receiver with reduced complexity.
[0008] The above object is achieved by a receiver according to claim 1 and a method according to claim 11. The broadcast system overcomes the obstacles to receiving line of sight (LOS) satellite signals in fixed and mobile radio receivers by using one or more terrestrial repeaters. The terrestrial repeater uses a QPSK-modulated time division multiplexing system (
TDM) receives a satellite signal, performs baseband processing on the satellite signal, and retransmits the satellite signal via multi-carrier modulation (MCM). A digital filter is employed that satisfies the requirements for QPSK satellite signal reception and reduces receiver complexity by acting as a downsampling filter prior to MCM demodulation of the terrestrial signal.
FIG. 1 illustrates a digital broadcast system 10 that includes at least one geostationary satellite 12 that receives a line-of-sight (LOS) satellite signal at a wireless receiver, generally indicated at 14. For the purpose of time and / or spatial diversity, another geosynchronous satellite 16 can be provided in a different orbital position as described below with respect to FIG. The system 10 further comprises at least one terrestrial repeater 18 for retransmitting satellite signals in a geographic area 20 where LOS reception is obscured by high rise buildings, hills and other obstacles. Radio receiver 14 is preferably configured for dual mode operation to receive both satellite and terrestrial signals and to select one of the signals as a receiver output.
The broadcast segment 22 and the terrestrial repeater segment 24 of the system 10 will be described with reference to FIG. The broadcast segment, as shown in block 26, divides the broadcast channel into 3.68 megabits per second (Mbps) time division multiplex (TD)
M) Preferably, encoding into a bitstream. The TDM bitstream contains 96 16 kilobits per second (kbps) prime rate channels and additional information for synchronization, demultiplexing, broadcast channel control and services. Broadcast channel coding preferably includes MPEG audio coding, forward error correction (FEC) and multiplex. The obtained T

The DM bit stream is transmitted via satellite uplink 30 after being modulated using quarter-phase shift keying (QPSK) modulation as shown in block 28.
With continued reference to FIG. 2, the terrestrial repeater segment includes a satellite downlink 32 and a demodulator 34 that performs QPSK demodulation to obtain a baseband TDM bitstream. Puncturing and delay block 36 reduces the TDM bit rate from 3.68 Mbps to 3.067 Mbps by removing selectable bits that can be reinserted at the wireless receiver, and reduces the time between transmissions from satellites 12 and 16. If there is a diversity delay, the entire TDM bit stream is delayed by the delay amount. The delayed and reduced rate bit stream is then multi-carrier modulated in block 38 and then amplified by amplifier 39 and transmitted from terrestrial repeater tower 40. Multi-carrier modulation converts a 3.067 Mbps TDM bit stream in the time domain into
Preferably, it includes splitting into 432 parallel paths each carrying 7100 bits / sec. Each bit is the imaginary (I) component of a complex number and the real (Q)
It is paired with two-bit symbols, each identified as a component. Therefore,
The complex symbol rate is 3550 symbols / second. The 432 parallel complex numbers are the inverse fast Fourier transform of 512 coefficients with 2 .sup.n inputs and outputs (
IFFT) operation is provided as a frequency coefficient input to a discrete Fourier inverse transform converter, which is preferably performed. Here, n = 9, and the 80 input coefficients are set to zero. The output of the IFFT is a set of 432 QPSK orthogonal sine coefficients, which support a symbol rate of 3550 / sec and make up 432 narrowband orthogonal carriers with a symbol period of 280 microseconds. I have.
FIG. 3 shows a frequency plan of the full diversity two satellite broadcasting system 10. In a preferred embodiment of the present system 10, satellites 12 and 16 of FIG. 1 broadcast the same programs A and B, respectively. Programs A and B are transmitted via "after" satellites 16 after transmission by "early" satellites 12. The frequency plan allocates a frequency band to each of the four QPSK modulated satellite signals indicated by reference numerals 42, 44, 46 and 48 in FIG. Further, two frequency bands 50 and 52 are included in the multi-carrier modulated program A and B signals transmitted from the terrestrial repeater. And retransmit this signal with sufficient delay to time synchronize the signal from the earlier satellite 12 with that transmitted by the later satellite 16. In the frequency plan, the channel separation is relatively small, with each of the six frequency bands 42-52 occupying about 2.07 megahertz (MHz) in the entire 12.5 MHz frequency bandwidth.
Referring to FIG. 4, a first arm 54 receives a QPSK signal from the preceding satellite 12 and a second arm receives a QPSK signal from the succeeding satellite 16 and receives an MCM signal from the terrestrial repeater 18. A dual-mode wireless receiver including an arm 56 and a combiner 58 that generates a receiver output from two received signals will be described. With the two arms 54 and 56, full diversity reception is possible. As a dual mode receiver arm for receiving satellite signals and terrestrial signals, QPSK / MCM of a wireless receiver
An arm 56 is used. The QPSK signals received from satellites 12 and 16 are:
Demodulated in blocks 60 and 62, respectively. Also, the MCM signal from the terrestrial repeater 18 (consisting of a delay and multi-carrier modulation of the signal transmitted by the satellite 12 above) is demodulated as shown in block 64. The depuncturing unit 66 re-inserts bits into the demodulated signal from the terrestrial repeater,
Increase the bit rate to the rate of the original TDM bit stream.
The QPSK / MCM receiver arm 56 is configured to detect when a terrestrial repeater signal is present, as shown at block 67, and replace the terrestrial repeater signal instead of a later signal from the satellite 16. Selection is made via the selector 68. In a broadcast system having at least one satellite and at least one terrestrial repeater, the band 50 of FIG.
The terrestrial signals at and 52 may be absent or negligible if the wireless receiver is in a rural area outside the range of the terrestrial repeater. If the wireless receiver is mobile and the user is using it while approaching an urban or urban area, both satellite and terrestrial signals can be received. On the other hand, when the wireless receiver is mobile and used while driving in an urban area, it is impossible to receive the LOS signal from the satellite, and in many cases, only the ground signal can be received. When the strength of the terrestrial signal exceeds a predetermined threshold, the dual mode receiver arm 56 of the wireless receiver switches from receiving a signal from the satellite 16 to receiving a signal from the terrestrial repeater 18. The details of the QPSK demodulators 60 and 62, the MCM demodulator 64, the

depuncturing unit 66, the terrestrial detector 67, and the selector 68 shown in FIG. 4 will be described later. The signal at the output of the QPSK demodulator 60 at the receiver arm 54 and the signal at the output of the selector 68 at the receiver arm 56 are TDM demultiplexed, as shown in blocks 70 and 72 of FIG. The decoded baseband bit stream is decoded. As shown in block 74, the bit stream reproduced from satellite 12 at receiver arm 54 is delayed by the amount of delay between broadcasts from earlier satellite 12 and later satellite 16 and the bit stream is received by receiver arm 56. Time synchronized with the generated bitstream. The signals from the receiver arms 54 and 56 are then post-detection diversity coupled (post-de-
After performing tection diversity combining, MPEG audio decoding is performed in block 78. It is understood that the radio receiver does not need to support satellite diversity, and therefore can be implemented only with the QPSK / MCM arm 56 without using the QPSK arm 54. In such a wireless receiver, the post-detection coupler 58 can also be omitted.

As shown in FIG. 3, the level of the terrestrial signal can be substantially higher than the satellite signal, eg, on the order of 30 decibels (dB) above the satellite signal. As mentioned above, the channel separation in the frequency plan is relatively small. For this reason, when a terrestrial signal exists in an adjacent channel as shown in FIG. 3, when decoding a satellite signal, it is necessary to perform filtering with a high attenuation of a stop band. Typically, such filtering is avoided by increasing the frequency separation between the satellite and terrestrial signal channels. If the separation is sufficient, a channel filter is used to suppress adjacent channels.

According to one embodiment of the invention, channel selection is performed using a filter that does not totally suppress adjacent channels. As will be described below, the presence of terrestrial repeater frequency bands 50 and 52 at the bottom of the frequency plan (and adjacent to frequency bands 46 and 48 of later satellites 16, respectively) allows the satellite signal or terrestrial to receiver output. Signal selection is simplified. Filtering will be described with QPSK demodulation followed by MCM demodulation, followed by filtering in a combined QPSK / MCM dual mode receiver arm (FIG. 12) configured according to a preferred embodiment of the present invention.

FIG. 5 shows a schematic block diagram of the QPSK satellite signal demodulation QPSK satellite signal receiver arm 80. An antenna 82 and a low noise amplifier (LNA) 84 on the wireless receiver side receive the signal at a carrier frequency of about 2.3 gigahertz (GHz). This signal is downconverted by mixer 86 and local oscillator 88 to a first intermediate frequency (IF) of about 135 MHz. The signal from mixer 86 is provided to a low loss surface acoustic wave (SAW) intermediate frequency (IF) filter 90, and to a second mixer 92 and a local oscillator 94, which are downconverted to a second IF of about 3.68 MHz. Is done.

For a strong SAW filter with better adjacent channel suppression, a weak or “leaky” SAW filter is preferred. As shown in FIG. 6, the terrestrial channel 50 immediately adjacent to the satellite channel 46 is partially within the SAW filter passband, and the attenuation of the interference channel 50 is only about 6 dB. Strong SAW

While filters can better remove adjacent channels (eg, channel 50), strong SAW filters can introduce phase distortion and have a weak S

It is more expensive to implement than an AW filter.

The QPSK satellite signal arm 80 of FIG. 5 includes a sampler 96 that samples the received signal at the output of the SAW filter 90 at a sampling rate that is four times the second IF. An analog-to-digital (A / D) converter 100 performs A / D conversion of the sampled signal, and a digital filter 102 removes adjacent channels (eg, channel 50) from the digitized satellite signal. Digital filter 102 is preferably matched to the broadcast station's transmit filter. The digital filter 102 may have a stop band attenuation of 30 dB or more depending on the SAW filter 90 and a signal-to-noise ratio (SNR) after the SAW filter 90. The output of the digital filter 102 is processed via a sampling switch and a latch element 104,

Recover the TDM signal from the SK modulation.

Digital filter 102 is preferably a root raised cosine (RRC) filter that is common in QPSK modulation and demodulation. In a preferred embodiment, the RRC filter has a sampling rate four times the IF and eight times the symbol rate transmitted in satellite signals from the originating broadcaster. In addition, a roll-off rate of (= 0.15 is selected. As shown in FIG. 7, the frequency response of the RRC filter has a pass band ripple of 0.1 dB and a stop band ripple of 40 dB. 3 representing the ideal RRC frequency response, the result of the Remez algorithm, and the RRC frequency response after coefficient quantization

Provides two plots. Such an RRC filter specification can be realized by a 136-tap linear phase finite impulse

response (FIR) filter having a fixed point coefficient of 10 bits and a word length of 16 bits.
[0023]MCM demodulation of ground signal FIG. 8 shows an MCM demodulator. At the time of MCM demodulation, radio receiver using FFT
IFFT implementing filter bank and MCM modulation at terrestrial repeater as described above
Corresponding to The input of the FFT shown in FIG.
Sampled according to parameters. The sampling frequency is
MCM symbol frequency F corresponding to the number of MCM symbols transmitted every second
from.sub.s Depends on. Furthermore, the sampling frequency depends on the FFT length and each MCM symbol.
Depending on the guard interval length associated with the The sampling frequency is F.sub.Four= F.sub.s.sup.*FFTLEN.sup.*(1 + GUARDLEN_REL) is preferable.
Here, FTTLEN corresponds to the FFT length (for example, 512), and GUARD
LEN_REL is the effective length or symbol period (eg, 280 microseconds)
Corresponding to the guard interval length for.sub.sCorresponds to the MCM symbol frequency
I do. MCM symbol frequency F.sub.sIs divided by the number of bits per MCM symbol.
Bit rate. As an example, the MCM signal bit rate is 3.067 mega
Bits / second (Mbps), and the number of bits per symbol is up to 864.
Or 432.
With continued reference to FIG. 8, an MCM signal of about 2.3 GHz
And received by a wireless receiver via a low noise amplifier (LNA) 108 and the mixer 11
0 and down-converted by the local oscillator 112 to an IF of about 135 MHz.
After that, it is processed by the SAW filter 114. The signal is output to the SAW filter 11
4 to avoid aliasing components. SAW filter bandwidth
Sampling frequency in width meets Nyquist criterion for sampling signal
. The received MCM signal is then converted to a second mixer 116 and a second local oscillator.
Using 118, it is down-converted to a second IF of about 4.60 MHz. Faith
The signal is sampled by the sampler 120 at a frequency above the bandwidth of this signal, ie, F.sub.Two > = 2.sup.*F.sub.1At a sampling frequency of Required sampling cycle
The wave number is higher than the desired terrestrial signal bandwidth as shown in FIG.
4 times higher than the bandwidth of the desired signal). Following the A / D conversion in block 122,
An adjacent channel is suppressed using the digital filter 124. Digital filter
124 indicates that the level of the adjacent satellite channel 46 is significantly lower than the terrestrial signal 50 (
That is, it is low on the order of 30 dB).
Filter. The adjacent satellite channel 46 is simply an A / D converter.
It appears as noise after conversion and downsampling. Digital low pass filter
The spectrum obtained after the ring is shown in FIG. Where the bandwidth is F.sub.ThreeIs equivalent to is there. The signal then has a lower sampling frequency F.sub.Four> = 2.sup.*F.sub.ThreeRepresented by
Down-sampling is performed. Frequency F.sub.TwoAnd F.sub.FourIs F.sub.FourIs N.sup.*F.sub.Two Where N is an integer, for example, four.
The output of digital low-pass filter 124 after downsampling in block 126 is subjected to an FFT as part of the MCM demodulation process as shown in FIG.
Supplied to The samples are converted to vectors by a serial-to-parallel conversion, then converted to the frequency domain by FFT, and then decoded via an inverse mapping process. The mapping process converts the output of the FFT in the form of a complex-valued data vector into an output bitstream.
Dual mode receiver QPSK modulation is an efficient method for satellite broadcasting, while MCM modulation is effective for terrestrial broadcasting. A system that uses satellite broadcasting in rural and suburban areas, for example, in a city center where satellite signals are shielded by high-rise buildings, requires a merged receiver to receive both satellite and terrestrial signals in a terrestrial broadcasting system It is said.
One possible dual mode receiver is shown in FIG. This dual mode receiver can be used as a satellite / ground arm 56 in the wireless receiver 14 of FIG. If the satellite and terrestrial signals use the same

frequency, a common tuner 129 can be used. The QPSK arm 130 and MCM arm 132 of the dual mode receiver can be the same as the QPSK demodulator and MCM demodulator described above with respect to FIGS. 5 and 8, respectively.
According to a preferred embodiment of the present invention, for example, a dual mode receiver implementing a satellite / terrestrial arm of a wireless receiver is implemented using a combined architecture for QPSK modulation and MCM demodulation. This common architecture is shown in FIG. The dual mode receiver shown in FIG. 12 requires only one SAW filter and one digital filter, and is suitable for reducing the cost and complexity of the receiver as compared with the receiver shown in FIG.
Referring to FIG. 12, antenna 134 and LNA 1 for receiving satellite and terrestrial signals, preferably at a frequency in the range of 2.332 to 2.345 GHz,
36 are provided. Received satellite and terrestrial signals are weak or "leaky" SAW
The filter is supplied to the same SAW filter 132, which is preferably a filter. As described above, a weak SAW filter is preferable to a strong SAW filter that is excellent in suppressing adjacent channels, because a strong SAW filter may cause phase distortion and is expensive to implement. . As shown in FIG. 6, the passband of a weak SAW filter attenuates terrestrial signals in adjacent channels by only about 6 dB. This partial suppression of the adjacent channel is preferable in that it enables detection of a terrestrial signal.
The dual mode receiver is configured to select a received terrestrial signal above the received satellite signal for receiver output whenever the terrestrial signal exceeds a predetermined threshold. Thus, dual mode receivers essentially search for terrestrial signals at all times and select satellite signals only when there is no terrestrial signal.
In the illustrated embodiment, two voltage controlled local oscillators 140 and 1
42, along with corresponding mixers 144 and 146, are provided with a selectively tuned superheterodyne phase-locked loop (PLL) 139 to divide the QPSK and MCM signals into two different second signals as described above with respect to FIGS. IF (
That is, they are down-converted to 3.68 MHz and 4.60 MHz, respectively. For example, oscillators 140 and 142 can both be locked to a single reference oscillator at 14.72 MHz and a phase comparator frequency of 230 kHz can be used.
At mixer 144, satellite and terrestrial signals in different frequency bands are mixed with different local oscillator input frequencies and these signals are downconverted to the same IF of about 135 MHz. For example, the mixer input frequency is F .sub.LO1
Is F .sub.terr -F .sub.IF , and F .sub.terr -2.07 MHz-F .sub.IF in a satellite signal.
At mixer 146, the sampling frequency depends on whether the receiver is using a terrestrial signal or a satellite signal for the receiver output. Mixer 146 is preferably retuned to achieve a second IF that is 1/4 of the sampling frequency used. The sampling frequency used is MCM
It is preferably an integral multiple of 2.3 MHz for terrestrial signals and an integral multiple of 1.84 MHz for QPSK / TDM satellite signals. Therefore, the mixer 146
Is retuned to facilitate simplification of I / Q generation. Feedback data from the terrestrial detection circuit described below is supplied to a superheterodyne PLL circuit 139, and depending on whether a sufficiently strong terrestrial signal has been detected and whether it is being used for a receiver output instead of a satellite signal. By the local oscillators 140 and 1
42 is controlled.
The digital filter 148 of FIG. 12 also downsamples the MCM signal (eg, the RRC filter described above with respect to FIGS. 5 and 7) as required for QPSK demodulation. Sampling frequency F .sub.4 = N .sup.* 2.3 MHz, where N = 8) Implemented to meet the requirements of the digital filter used before FFT processing.
When the receiver is first powered up, the receiver configures local oscillators 140 and 142 to down convert the satellite signal to a second 3.68 MHz IF. The sampling and A / D conversion of the satellite signal in blocks 150 and 152 are as described above. In the RRC filter, a sampling rate four times the IF (or eight times the symbol rate) is used. The passband of the RRC filter is configured such that the filter does not pass energy of adjacent terrestrial signals. If a terrestrial signal of sufficient energy is present in channel 50 adjacent to the satellite signal carried by the SAW filter, a difference in signal energy can be detected between the input and output of the RRC filter. This is performed by the ground signal detector 154 of FIG.

The ground signal detector 154 compares the signal energy at the input of the filter with the signal energy at the output of the filter. If the energy at the input of the filter is very high compared to the output of the filter (eg, 3 times higher, depending on the SAW filter frequency response), it is assumed that a terrestrial signal has been received.
When a terrestrial signal is present in an adjacent channel, a signal is generated by terrestrial signal detector 154 retuning local oscillators 144 and 146 to downconvert the terrestrial signal. Therefore, the center frequency of the terrestrial signal is shifted by about 2.07 MHz, and the second IF becomes 4.60 MHz.
Sampling and A / D
Following conversion, the terrestrial signal is applied to a digital filter 148 of the RRC type. The digital filter passes the MCM terrestrial signal to block 156 because the roll-off frequency of digital filter 148 is selected to meet the requirements of both QPSK demodulation and MCM demodulation, and the terrestrial and satellite signal bandwidths are similar. After down-sampling, an FFT process is performed in block 158. The output of the digital filter 148 is also supplied to the sampling switch and latch element 1.
60 to reproduce the TDM signal from the QPSK modulation performed at the broadcast station. Next, the switch 162 is used to select an output signal from either the sampling switch and the latch element 160 or the FFT 158, and the TDM demultiplexing and decoding circuit 164 and the post-detection diversity combiner 58 (FIG. 4).
Further processing via). The operation of the switch 162 is controlled by the ground signal detector 154.
Thus, at the bottom of the frequency plan (FIG. 3), adjacent to the satellite signal frequency bands 46 and 48, are the terrestrial repeater frequency bands 50 and 52 so that the satellite signal or terrestrial signal to receiver output is Signal selection becomes easier. Since a part of the adjacent ground signal remains in the output of the SAW filter during the reception of the satellite signal, the ground signal can be detected by comparing the signal powers.
While the preferred embodiments have been chosen to describe the invention, various changes and modifications can be made without departing from the scope of the invention as set forth in the appended claims. Will be understood by those skilled in the art.
[Brief description of the drawings]
FIG. 1 shows a digital broadcasting system for transmitting satellite signals and terrestrial signals.
FIG. 2 is a block diagram showing a broadcast segment and a terrestrial repeater segment of the digital broadcasting system according to the preferred embodiment of the present invention.
FIG. 3 shows a frequency plan of a satellite signal and a terrestrial signal in a full diversity broadcasting system according to a preferred embodiment of the present invention.
FIG. 4 is a block diagram of a satellite and terrestrial signal receiver configured in accordance with a preferred embodiment of the present invention.
FIG. 5 is a block diagram of a 1/4 phase shift keyed (QPSK) satellite signal receiver arm configured in accordance with a preferred embodiment of the present invention.
FIG. 6 shows the frequency response of a surface acoustic wave (SAW) filter for satellite and terrestrial signals according to a preferred embodiment of the present invention.
FIG. 7 shows a frequency response of a digital filter of a satellite signal according to a preferred embodiment of the present invention.
FIG. 8 is a block diagram of a multi-carrier modulated (MCM) terrestrial signal receiver arm configured in accordance with a preferred embodiment of the present invention.
FIG. 9 is a diagram showing M after surface acoustic wave filtering according to a preferred embodiment of the present invention;
4 shows a frequency response of a CM ground signal.
FIG. 10 shows the frequency response of an MCM ground signal after digital filtering according to a preferred embodiment of the present invention.
FIG. 11 is a block diagram of a receiver configured to receive both QPSK satellite signals and MCM terrestrial signals.
FIG. 12 shows a QPSK satellite signal and an MCM according to a preferred embodiment of the present invention.
FIG. 2 is a block diagram of a receiver having a composite architecture for receiving and demodulating terrestrial signals.

Designated country EP (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OA (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), AP (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), EA (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK , LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW (72) Inventor Rip, Stefan Germany, Erlangen D-91058, Steinweg 9A (72) Inventor Buchholz, Stefan Germany, Munich D-81447, Kerschlasher Strasse 8 (72) Inventor Huberger, Albert Germany, Erlangen D-91056, Hauseckerweg 18 (72) Inventor Gerhauser, Heinz Germany, Weischenfeld D-91344, Saugendorf 17 F term (reference) 5K004 AA05 AA08 FA05 FG00 FG01 FH01

Claims

1. A receiver configured to receive both broadcast signals of a first signal type and a second signal type, and to select and output one of the broadcast signals of the signal type, A first oscillator and a mixer circuit for down-converting both broadcast signals of one signal type and the second signal type to a first intermediate frequency, a center frequency corresponding to the first intermediate frequency, and the first signal A first filter having a frequency response selected to carry at least a portion of the broadcast signal of the type and the broadcast signal of the second signal type; and a broadcast signal of the first signal type and the broadcast signal. A second oscillator and a mixer circuit for down-converting the broadcast signal of the second signal type to a second intermediate frequency; and the broadcast signal and the mixer circuit of the first signal type. Sampling and analog-converting the broadcast signal of the fine the second signal type into digital signals - and the digital conversion circuit, the sampling and analog - is connected to the output of the digital conversion circuit,
Phase shift keying, ie the digital signal generated from the broadcast signal of the first signal type which is PSK modulated, and the broadcast signal of the second signal type which is modulated according to a second modulation scheme different from the PSK modulation A second filter for filtering the digital signal generated from the second signal type, and determining whether a characteristic of the second signal type exceeds a predetermined threshold value, and A signal detection circuit for generating an output signal for controlling the operation of the oscillator and the mixer circuit, wherein the first oscillator and the mixer circuit generate the first intermediate frequency by mixing the broadcast signal. A signal detection circuit configured to use one of a first and a second input frequency according to the output signal; A first signal demodulation device connected to the first filter for processing the first signal type; a second signal demodulation device connected to the second filter for processing the second signal type; A switching element for selecting one of the outputs of the signal demodulation device and the second signal demodulation device according to the output signal from the signal detection element.
2. A third filter is used in generating the broadcast signal of the first signal type, wherein the second filter has a frequency response of a matched filter corresponding to the third filter. The receiver of claim 1, wherein the receiver is configured.
3. The method of claim 2, wherein the second modulation scheme is multi-carrier modulation, ie, MCM, and wherein the second filter is configured to have a frequency response that facilitates MCM and PSK demodulation. The receiver according to 1.
4. The frequency response corresponds to a fast Fourier transform length of MCM demodulation and a sampling frequency adapted to MCM demodulation corresponding to at least one of a guard interval length used during MCM modulation. The receiver described.
5. The second signal type is a multi-carrier modulated signal demodulated using a down-sampling and fast Fourier transform process, and wherein the second filter is configured to perform the down-sampling and the second signal type of the second signal type. The receiver of claim 1, configured to perform in accordance with the fast Fourier transform process as well as filter parameters selected to facilitate PSK demodulation of the first signal type.
6. The filter of claim 1, wherein the second filter is a root raised cosine filter having a frequency response selected to facilitate demodulation of both the first signal type and the second signal type. Receiver.

7. The reception of claim 6, wherein the second filter is a matched filter configured to substantially correspond to a third filter at a broadcast station that generated the first signal type. Machine.
8. The receiver according to claim 1, wherein the first filter is a leakage filter selected from the group consisting of a surface acoustic wave filter and a ceramic filter.
9. The second signal type has a higher signal level than the first signal type, and the signal detection circuit detects the second signal level at the input / output of the second filter.
The receiver of claim 1, wherein the receiver is configured to determine a difference in signal level of a signal type.
10. A method for determining whether the characteristic of the second signal type exceeds a predetermined threshold value, wherein the characteristic value is connected to the second filter, and when the characteristic exceeds the predetermined threshold value. A signal detection circuit for controlling the second oscillator and the mixer circuit to perform down-conversion using the third intermediate frequency and generating an output signal for controlling the operation of the second oscillator and the mixer circuit
The receiver according to claim 1, further comprising:
11. A method for receiving and selecting from broadcast signals transmitted on first and second frequency channels, comprising: receiving a signal on a carrier frequency; and a broadcast signal on the second frequency channel. Depends on whether or not exceeds a predetermined threshold, using one of the first and second input frequencies to convert the received signal to a first
Down-converting to an intermediate frequency of; and filtering said received signal to carry said broadcast signal on both said first and second frequency channels; and said first frequency channel and said second
Down-converting the broadcast signal in a frequency channel to a second intermediate frequency; sampling and converting the broadcast signal into a digital signal; and filtering the digital signal, wherein the digital signal is The digital signal generated from the channel is phase shift keyed, ie, PSK modulated, and the filtering step is performed using a root raised cosine filter to facilitate PSK demodulation, generated from the second frequency channel. The day The digital signal is modulated according to a second modulation scheme different from the PSK modulation, and the filtering is performed using the root raised cosine filter; and wherein the filtering is performed from the first frequency channel. Demodulating a filtered digital signal and demodulating the filtered signal generated from the second frequency channel; and the demodulated signal or the second frequency generated from the first frequency channel. Selecting the demodulated signal generated from a channel based on whether the broadcast signal on the second frequency channel exceeds a predetermined threshold;
A method that includes
12. The filtering step comprises filtering the root raised cosine filter to have a frequency response of a matched filter corresponding to a third filter used to generate the broadcast signal on the first frequency channel. The method of claim 11, comprising the step of selecting.
13. The method of claim 11, wherein said second modulation scheme is multi-carrier modulation or MCM, and wherein said providing step comprises selecting said frequency response to facilitate MCM demodulation.
14. The frequency response is selected according to a sampling frequency of MCM demodulation corresponding to at least one of a fast Fourier transform length used for MCM demodulation and a guard interval length during MCM modulation. 14. The method of claim 13, comprising steps.
15. The broadcast signal on the second frequency channel has a higher signal level than the broadcast signal on the first frequency channel, and further compares the signal level of the digital signal before and after the filtering step. Determining whether the characteristic of the broadcast signal in the second frequency channel exceeds a predetermined threshold value; and determining whether the broadcast signal in the second frequency channel has been detected. Generating a detection signal indicative of: adjusting the input frequency to a local oscillator according to the detection signal, and mixing the received signal in the first and second frequency channels with the first signal. 14. The method of claim 11, comprising: downconverting to an intermediate frequency of.

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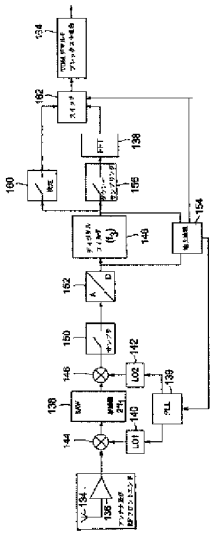
最終頁に続く

(54)【発明の名称】　ディジタル放送システムにおいて衛星信号および地上信号を受信するデュアルモード受信機

(57)【要約】
ＱＰＳＫ変調される衛星信号およびマルチキャリア変調される（ＭＣＭ）地上信号を受信するデュアルモード受信機が提供される。本デュアルモード受信機は、ＱＰＳＫおよびＭＣＭ復調をともに促進するように選択される最小数のフィルタを備えるえる複合アーキテクチャを有する。



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【特許請求の範囲】

【請求項１】

第１信号タイプおよび第２信号タイプの放送信号をともに受信し、かつ前記信号タイプの一方の放送信号を選択して出力するように構成される受信機であって、

前記第１信号タイプおよび前記第２信号タイプの前記放送信号をともに第１の中間周波数にダウンコンバートする第１の発振器およびミクサ回路と、

前記第１の中間周波数に対応する中心周波数と、前記第１信号タイプの前記放送信号および前記第２信号タイプの前記放送信号の少なくとも一部を搬送するように選択される周波数応答と、を有する第１のフィルタと、

前記第１信号タイプの前記放送信号および前記第２信号タイプの前記放送信号を第２の中間周波数にダウンコンバートする第２の発振器およびミクサ回路と、

前記第１信号タイプの前記放送信号および前記第２信号タイプの前記放送信号をディジタル信号に変換するサンプリングおよびアナログーディジタル変換回路と、

前記サンプリングおよびアナログーディジタル変換回路の出力に接続される、位相シフトキーイング、すなわちＰＳＫ変調される前記第１信号タイプの前記放送信号から生成される前記ディジタル信号と、ＰＳＫ変調と異なる第２の変調方式にしたがって変調される前記第２信号タイプの前記放送信号から生成される前記ディジタル信号をフィルタリングする第２のフィルタと、

前記第２のフィルタに接続され、前記第２信号タイプの標数が所定のしきい値を越えるかを判定し、かつ前記第１の発振器およびミクサ回路の動作を制御する出力信号を生成する信号検出回路であって、前記第１の発振器およびミクサ回路が、前記放送信号を混合することによって前記第１の中間周波数を生成するために、前記出力信号によって第１および第２の入力周波数の一方を使用するように構成される信号検出回路と、

前記第２のフィルタに接続され、前記第１信号タイプを処理する第１の信号復調装置と、

前記第２のフィルタに接続され、前記第２信号タイプを処理する第２の信号復

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調装置と、
前記第１の信号復調装置および前記第２の信号復調装置の一方の出力を、前記信号検出素子からの前記出力信号に応じて選択するスイッチング素子と、
を備える受信機。
【請求項２】
前記第１信号タイプの前記放送信号を生成する際に第３のフィルタが使用され、前記第３のフィルタに対応する整合フィルタの周波数応答を有するように前記第２のフィルタが構成される、請求項１記載の受信機。
【請求項３】
前記第２の変調方式は、マルチキャリア変調、すなわちＭＣＭであり、前記第２のフィルタは、ＭＣＭおよびＰＳＫ復調を促進するような周波数応答を有するように構成される、請求項１記載の受信機。
【請求項４】
前記周波数応答は、ＭＣＭ復調の高速フーリエ変換長と、ＭＣＭ変調中に使用されるガードインターバル長の少なくとも１つに対応するＭＣＭ復調に合わせたサンプリング周波数に対応する、請求項３記載の受信機。
【請求項５】
前記第２信号タイプは、ダウンサンプリングおよび高速フーリエ変換処理を使用して復調されるマルチキャリア変調信号であり、前記第２のフィルタが、前記第２信号タイプの前記ダウンサンプリングおよび前記高速フーリエ変換処理ならびに前記第１信号タイプのＰＳＫ復調を促進するように選択されるフィルタパラメタにしたがって実行するように構成される、請求項１記載の受信機。
【請求項６】
前記第２のフィルタは、前記第１信号タイプおよび前記第２信号タイプの両方の復調を促進するように選択される周波数応答を有するルートレイズドコサインフィルタである、請求項１記載の受信機。
【請求項７】
前記第２のフィルタは、前記第１信号タイプを生成した放送局にある第３のフィルタに実質的に対応するように構成される整合フィルタである、請求項６記載

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の受信機。

【請求項８】

前記第１のフィルタは、表面弾性波フィルタおよびセラミックフィルタからなる群から選択される漏洩フィルタである、請求項１記載の受信機。

【請求項９】

前記第２信号タイプは、前記第１信号タイプより高い信号レベルであることを特徴とし、前記信号検出回路が、前記第２のフィルタの入出力における前記第２信号タイプの信号レベルの差を決定するように構成される、請求項１記載の受信機。

【請求項１０】

前記第２のフィルタに接続され、前記第２信号タイプの標数が、所定のしきい値を越えるか否かを判定し、かつ前記所定のしきい値を越えている場合に前記第３の中間周波数を用いてダウンコンバートを実行するよう前記第２の発振器およびミクサ回路を制御し前記第２の発振器およびミクサ回路の動作を制御するための出力信号を生成する信号検出回路をさらに備える、請求項１記載の受信機。

【請求項１１】

第１および第２の周波数チャネルで伝送される放送信号から受信し、かつ選択する方法であって、

キャリア周波数で信号を受信するステップと、

前記第２の周波数チャネルにおける放送信号が所定のしきい値を越えるか否かによって、第１および第２の入力周波数の一方を使用して、前記受信信号を第１の中間周波数にダウンコンバートするステップと、

前記受信信号をフィルタリングして、前記第１および第２の周波数チャネルの両方において前記放送信号を搬送するステップと、

前記第１の周波数チャネルおよび前記第２の周波数チャネルにおける前記放送信号を第２の中間周波数にダウンコンバートするステップと、

前記放送信号をディジタル信号にサンプリングして変換するステップと、

前記ディジタル信号をフィルタリングするステップであって、前記第１の周波数チャネルから生成される前記ディジタル信号が、位相シフトキーイング、すな

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わちＰＳＫ変調され、ＰＳＫ復調を促進するように前記フィルタリングステップがルートレイズドコサインフィルタを用いて実施され、前記第２の周波数チャネルから生成される前記ディジタル信号は、ＰＳＫ変調と異なる第２の変調方式にしたがって変調され、かつそのフィルタリングが、前記ルートレイズドコサインフィルタを用いて実施される、フィルタリングステップと、

前記第１の周波数チャネルから生成される前記フィルタリングされたディジタル信号を復調し、かつ前記第２の周波数チャネルから生成される前記フィルタリングされた信号を復調するステップと、

前記第１の周波数チャネルから生成される前記復調信号または前記第２の周波数チャネルから生成される前記復調信号を、前記第２の周波数チャネルにおける前記放送信号が所定のしきい値を越えるか否かによって選択されるステップと、を含む方法。

【請求項１２】

前記フィルタリングステップは、前記第１の周波数チャネルで前記放送信号を生成するために使用される第３のフィルタに対応する整合フィルタの周波数応答を有するように前記ルートレイズドコサインフィルタを選択するステップを含む、請求項１１記載の方法。

【請求項１３】

前記第２の変調方式はマルチキャリア変調すなわちＭＣＭであって、前記提供ステップは、ＭＣＭ復調を促進するように前記周波数応答を選択するステップを含む、請求項１１記載の方法。

【請求項１４】

前記選択ステップは、ＭＣＭ復調に使用される高速フーリエ変換長とＭＣＭ変調中のガードインターバル長の少なくとも１つに対応するＭＣＭ復調のサンプリング周波数に応じて、前記周波数応答を選択するステップを含む、請求項１３記載の方法。

【請求項１５】

前記第２の周波数チャネルにおける前記放送信号は、前記第１の周波数チャネルにおける前記放送信号より高い信号レベルを有し、さらに

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前記フィルタリングステップの前後に前記ディジタル信号の信号レベルを比較して、前記第２の周波数チャネルにおける前記放送信号の標数が所定のしきい値を越えるか否かを判定するステップと、

前記第２の周波数チャネルにおける前記放送信号が検出されているか否かを示す検出信号を生成するステップと、

前記検出信号にしたがって局部発振器に対する入力周波数を調整して、前記第１および第２の周波数チャネルにおける前記受信信号を混合することによって前記受信信号を前記第１の中間周波数にダウンコンバートするステップと、

を含む、請求項１１記載の方法。

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【発明の詳細な説明】

【０００１】

［発明の背景および概要］

本発明は、提案されるディジタル音声無線サービス（ＤＡＲＳ）等、衛星信号と地上信号の両方を受信する複合アーキテクチャを有するディジタル放送システムにおいて使用される受信機に関する。

【０００２】

ＵＳ－Ａ－５，６００，６７２は、第１および第２のデータストリームを受信側の受信信号から取り出すことが可能な通信システムに関連する。データストリームの一方を選択して、アナログ－ディジタル変換、フィルタリング、キャリア再生、位相同期化および復号を含むさらなる処理を行うことができる。

【０００３】

ＵＳ－Ａ－４，３５５，４０１は、アナログ信号およびディジタル角変調されたキャリア波信号を受信する受信部を有する無線装置を開示している。アナログ信号およびディジタル信号をそれぞれ復調する第１および第２の復調器が提供されている。決定回路は、クロック再生回路の出力に応答して、受信信号がアナログＦＭ波であるか、またはディジタルＦＭ波であるかを決定する。決定に応じて、復調されたアナログ信号または復調されたディジタル信号は、スイッチング手段により選択的に搬送される。

【０００４】

ＥＰ－Ａ－０５７４２７３は、ＡＭ－ＦＭ結合の復調器を有する受信機を示す。受信機は、共通発振器とミクサ回路とを有する。アナログ変調信号が受信されると、共通発振器およびミクサ回路の局部発振器の周波数は、周波数誤差検出器を利用して制御される。受信機は、さらに、アナログ変調信号の復調器と、ディジタル変調信号の復調器とが並列接続されている変調器を含む。ディジタル変調信号復調器にはディジタル変調信号弁別器が接続され、受信機を適切な復調モードに切り換える。

【０００５】

ＥＰ－Ａ－０７６９８７３は、直交振幅変調等の変調信号および残留側波帯Ｒ

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Ｆ入力信号等を１つ以上受信するように適合されるＲＦ受信機に関する。ＲＦ信号は、通過帯域フィルタリングされ、３個のバンドパスフィルタおよび２個のミクサを用いてダウンコンバートされ、第３のバンドパスフィルタの出力がサンプル及びホールド回路に印加される。サンプル及びホールド回路の出力は、ローパスフィルタを介してアナログーディジタルコンバータに結合され、その出力が、サンプリングされた信号を復調し、かつベースバンド信号を生成するヒルベルトフィルタに印加される。

【０００６】

Groshong R. et. al.の「アンダーサンプリング技術はディジタル無線を簡単にする(Undersampling Techniques Simplify Digital Radio)」Electronic Design（電子設計）、第３９巻、第１０号、１９９１年5月２３日、第６７～６８、７０、７３～７５、７８頁には、広帯域入力フィルタと、第１のＩＦミクサと、第１のＩＦ狭帯域フィルタと、固定発振周波数を有する第２のＩＦミクサと、選択可能な第２のＩＦフィルタと、ＡＭ用とＦＭ用の別個の復調器と、を備える典型的なヘテロダイン受信機が記載されている。

【０００７】

［発明の概要］

本発明の目的は、複雑性を低減した受信機を用いて衛星信号および地上信号の受信を可能にする、放送信号の受信装置および方法を提供することである。

【０００８】

上記目的は、請求項１記載の受信機および請求項１１記載の方法により達成される。

【０００９】

本放送システムは、地上中継器を１つ以上使用することによって、固定式および移動式無線受信機における見通線（ＬＯＳ：line of sight）衛星信号受信に対する障害物を克服する。地上中継器は、ＱＰＳＫ変調された時分割多重方式（ＴＤＭ）衛星信号を受信し、衛星信号のベースバンド処理を実行し、マルチキャリア変調（ＭＣＭ）を介して衛星信号を再送信する。ＱＰＳＫ衛星信号受信の要件を満たすとともに地上信号のＭＣＭ復調前にダウンサンプリングフィルタとし

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て動作することによって受信機の複雑性を低減するディジタルフィルタが採用される。

【００１０】

［発明の実施の形態］

図１は、全体的に１４で示す無線受信機において見通線（ＬＯＳ）衛星信号受信を行う少なくとも１つの静止衛星１２を備えるディジタル放送システム１０を示す。時間および／または空間的ダイバーシチの目的で、図３について後述する異なる軌道位置にある別の静止衛星１６を設けることができる。システム１０は、ＬＯＳ受信が、高層建造物、丘および他の障害物によって掩蔽される地理的エリア２０において衛星信号の再送信を行う少なくとも１つの地上中継器１８をさらに備える。無線受信機１４は、衛星信号と地上信号の両方を受信し、かつ上記信号の一方を受信機出力として選択するためのデュアルモード動作のために構成されることが好ましい。

【００１１】

システム１０の放送セグメント２２および地上中継器セグメント２４について、図２を参照して説明していく。放送セグメントは、ブロック２６に示すように、放送チャネルを、３．６８メガビット／秒（Ｍｂｐｓ）時分割多重方式（ＴＤＭ）ビットストリームにエンコードすることを含むことが好ましい。ＴＤＭビットストリームは、９６個の１６キロビット／秒（ｋｂｐｓ）プライムレートチャネルと、同期化、デマルチプレックス、放送チャネルコントロールおよびサービスの追加情報とを含む。放送チャネル符号化は、ＭＰＥＧ音声コード化、順方向誤り訂正（ＦＥＣ）およびマルチプレックスを含むことが好ましい。得られたＴＤＭビットストリームは、ブロック２８に示すように１／４位相シフトキーイング（ＱＰＳＫ）変調を用いて変調された後、衛星アップリング３０を介して送信される。

【００１２】

引き続き図２を参照して、地上中継器セグメントは、衛星ダウンリンク３２と、ＱＰＳＫ復調を実行してベースバンドＴＤＭビットストリームを獲得する復調器３４と、を備える。パンクチャリングおよびディレイブロック３６は、無線受

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信機において再挿入可能な選択ビットを除去することによってＴＤＭビットレートを３．６８Ｍｂｐｓから３．０６７Ｍｂｐｓに低下させ、かつ、衛星１２および１６からの伝送間に時間ダイバーシチ遅延があれば、その遅延量だけＴＤＭビットストリーム全体を遅延する。遅延され、かつ低下されたレートビットストリームは、次に、ブロック３８においてマルチキャリア変調を施された後、増幅器３９により増幅され、地上中継器タワー４０から送信される。マルチキャリア変調は、時間ドメインにおける３．０６７ＭｂｐｓのＴＤＭビットストリームを、それぞれ７１００ビット／秒を搬送する４３２個のパラレルパスに分割することを含むことが好ましい。各ビットは、複素数の虚数（Ｉ）成分および実数（Ｑ）成分としてそれぞれ識別される２ビットシンボルのペアにされる。したがって、複素数シンボルレートは、３５５０シンボル／秒である。４３２個のパラレル複素数番号は、2^n個の入力および出力による５１２係数の高速フーリエ逆変換（ＩＦＦＴ）演算を用いて実行されることが好ましい離散フーリエ逆変換コンバータに対する周波数係数入力として提供される。ここでｎ＝９であり、８０個の入力係数はゼロに設定されている。ＩＦＦＴの出力は、４３２個のＱＰＳＫ直交正弦係数の集合であり、これが、３５５０／秒のシンボルレートをサポートし、かつ２８０マイクロ秒のシンボル期間を有する４３２個の狭帯域の直交キャリアを構成している。

【００１３】

フルダイバーシチの２衛星放送システム１０の周波数プランを図３に示す。本システム１０の好ましい実施の形態において、図１の衛星１２および１６は、同一番組ＡおよびＢをそれぞれ放送する。番組ＡおよびＢを、「先の」衛星１２が送信した後、「後の」衛星１６を介して送信する。周波数プランは、図３において４２、４４、４６および４８でそれぞれ示す４個のＱＰＳＫ変調の衛星信号のそれぞれに周波数帯域を割り当てる。さらに、地上中継器から送信されたマルチキャリア変調済みの番組ＡおよびＢ信号には、２個の周波数帯域５０および５２が割り当てられ、先の衛星１２からの信号を後の衛星１６により送信されたものと時間同期化するのに十分な遅延でこの信号を再送信する。周波数プランにおいて、チャネル分離は、比較的小さく、６個の周波数帯域４２～５２のそれぞれが

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、約２．０７メガヘルツ（ＭＨｚ）を１２．５ＭＨｚの周波数帯域幅全体の中で占有している。

【００１４】

図４を参照して、ＱＰＳＫ信号を先の衛星１２から受信する第１アーム５４と、ＱＰＳＫ信号を後の衛星１６から受信し、かつＭＣＭ信号を地上中継器１８から受信する第２アーム５６と、２つの受信信号から受信機出力を生成する結合器５８と、を備えるデュアルモード無線受信機を説明する。２つのアーム５４および５６により、フルダイバーシチ受信が可能である。衛星信号および地上信号の受信を行うデュアルモード受信機アームとして、無線受信機のＱＰＳＫ／ＭＣＭアーム５６が用いられる。衛星１２および１６から受信されるＱＰＳＫ信号は、ブロック６０および６２においてそれぞれ復調される。また、地上中継器１８からのＭＣＭ信号（先の衛星１２により送信された信号の遅延およびマルチキャリア変調されたものからなる）も、ブロック６４に示すように復調される。デパンクチャリングユニット６６は、地上中継器からの復調信号にビットを再挿入し、ビットレートを元のＴＤＭビットストリームのレートに増大する。

【００１５】

ＱＰＳＫ／ＭＣＭ受信機アーム５６は、ブロック６７に示すように地上中継器信号がいつ存在するかを検出するように構成され、後の衛星１６からの信号の代わりに地上中継器信号を選択器６８を介して選択する。少なくとも１つの衛星と少なくとも１つの地上中継器とを有する放送システムにおいて、図３の帯域５０および５２における地上信号は、無線受信機が地上中継器のレンジ外の地方エリアにある場合には無くてもよいか、または無視できる。無線受信機が移動式であって、ユーザが都会または都市エリアに接近中に使用している場合、衛星および地上信号が、ともに受信可能である。一方、無線受信機が移動式であって、都会で運転中に使用している場合、衛星からのＬＯＳ信号の受信が不可能であるため多くの事例において地上信号しか受信できない。地上信号の強度が所定のしきい値を越えると、無線受信機のデュアルモード受信機アーム５６は、衛星１６からの信号の受信から地上中継器１８からの信号の受信に切り替わる。図４に図示のＱＰＳＫ復調器６０および６２、ＭＣＭ復調器６４、デパンクチャリングユニッ

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ト６６、地上検波器６７ならびに選択器６８については、さらに詳細を後述する。

【００１６】

受信機アーム５４におけるＱＰＳＫ復調器６０の出力の信号、および受信機アーム５６における選択器６８の出力の信号は、図４のブロック７０および７２に示すように、ＴＤＭデマルチプレックスされ、復号されて、ベースバンドビットストリームを再生する。ブロック７４に示すように、受信機アーム５４において衛星１２から再生されたビットストリームは、先の衛星１２と後の衛星１６からの放送間の遅延量だけ遅延され、ビットストリームを受信機アーム５６により生成されるビットストリームと時間同期化させる。受信機アーム５４および５６からの信号は、次に、ブロック５８に示すように検出後ダイバーシチ結合(post-detection diversity combining)を施された後、ブロック７８においてＭＰＥＧ音声復号される。なお、無線受信機は、衛星ダイバーシチをサポートする必要はないため、ＱＰＳＫアーム５４を用いずにＱＰＳＫ／ＭＣＭアーム５６のみで実施可能であることが理解される。かかる無線受信機において、検出後結合器５８も省略することができる。

【００１７】

図３に示すように、地上信号のレベルは、実質的に衛星信号より高く、たとえば、衛星信号より３０デシベル（ｄＢ）のオーダで高くすることができる。上述したように、周波数プランにおけるチャネル分離は比較的小さい。このため、図３に示すように地上信号が隣接チャネルに存在する場合、衛星信号を復号する際には、ストップバンド高減衰量をともなうフィルタリングが必要となる。通常は、かかるフィルタリングは、衛星信号チャネルと地上信号チャネルとの周波数分離を増大することによって回避される。分離が十分の場合、隣接チャネルを抑止するためにチャネルフィルタが使用される。

【００１８】

本発明の１つの実施形態によれば、チャネル選択は、隣接チャネルを全体的に抑止しないフィルタを用いて実施される。後述するように、周波数プランの下部に（および後の衛星１６の周波数帯域４６および４８にそれぞれ隣接して）地上

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中継器周波数帯域５０および５２があることで、受信機出力に対する、衛星信号または地上信号の選択が簡易になる。フィルタリングについては、ＱＰＳＫ復調、次いでＭＣＭ復調とともに説明した後、本発明の好ましい実施の形態にしたがって構成される結合ＱＰＳＫ／ＭＣＭデュアルモード受信機アーム（図１２）におけるフィルタリングを説明する。

【００１９】

ＱＰＳＫ衛星信号復調

ＱＰＳＫ衛星信号受信機アーム８０の概略ブロック図を図５に示す。無線受信機側のアンテナ８２および低雑音増幅器（ＬＮＡ）８４は、約２．３ギガヘルツ（ＧＨｚ）のキャリア周波数で信号を受信する。この信号は、ミクサ８６および局部発振器８８により約１３５ＭＨｚの第１の中間周波数（ＩＦ）にダウンコンバートされる。ミクサ８６からの信号は、低損失の表面弾性波（ＳＡＷ）中間周波数（ＩＦ）フィルタ９０、そして第２のミクサ９２および局部発振器９４に供給され、約３．６８ＭＨｚの第２のＩＦにダウンコンバートされる。

【００２０】

より優れた隣接チャネル抑止性を有する強力なＳＡＷフィルタに対しては、弱または「漏洩」ＳＡＷフィルタが好ましい。図６に図示するように、衛星チャネル４６に直に隣接している地上チャネル５０は、一部がＳＡＷフィルタパスバンド内に存在し、この干渉チャネル５０の減衰量は僅か約６ｄＢである。強ＳＡＷフィルタの方が隣接チャネル（たとえば、チャネル５０）をより良好に除去可能であるが、強ＳＡＷフィルタは、位相ひずみを招く可能性があるとともに、弱ＳＡＷフィルタに比べて実施が高価である。

【００２１】

図５のＱＰＳＫ衛星信号アーム８０は、ＳＡＷフィルタ９０の出力において受信信号を、第２のＩＦの４倍のサンプリングレートでサンプリングするサンプラ９６を含む。アナログ－ディジタル（Ａ／Ｄ）コンバータ１００は、サンプリングされた信号のＡ／Ｄ変換を実行し、ディジタルフィルタ１０２は、ディジタル化された衛星信号から隣接チャネル（たとえば、チャネル５０）を除去する。ディジタルフィルタ１０２は、好ましくは放送局の送信フィルタに整合される。デ

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ィジタルフィルタ１０２は、ＳＡＷフィルタ９０、およびＳＡＷフィルタ９０の後の信号対雑音比（ＳＮＲ）によっては、ストップバンド減衰量が３０ｄＢ以上であってもよい。そしてディジタルフィルタ１０２の出力は、サンプリングスイッチおよびラッチ素子１０４を介して処理され、放送局において実行されるＱＰＳＫ変調からＴＤＭ信号を回収する。

【００２２】

ディジタルフィルタ１０２は、好ましくはＱＰＳＫ変調および復調において一般的なルートレイズドコサイン（ＲＲＣ）フィルタである。好ましい実施の形態において、ＲＲＣフィルタは、サンプリングレートが、ＩＦの４倍であり、かつ発信放送局からの衛星信号において送信されるシンボルレートの８倍である。さらに、（＝０．１５のロールオフ率が選択される。図７に示すように、ＲＲＣフィルタの周波数応答は、パスバンドリップルが０．１ｄＢ、ストップバンドリップルが４０ｄＢである。図７は、理想的なＲＲＣ周波数応答、レメズアルゴリズム(Remez algorithm)の結果、および係数量子化後のＲＲＣ周波数応答を表す３つのプロットを提供する。かかるＲＲＣフィルタ仕様は、１０ビットの固定点係数と１６ビットのワード長を有する１３６タップの線形位相有限インパルス応答（ＦＩＲ）フィルタにより実現できる。

【００２３】

地上信号のＭＣＭ復調

図８にＭＣＭ復調器を示す。ＭＣＭ復調の際、ＦＦＴを利用して無線受信機でフィルタバンクを実施し、地上中継器でのＭＣＭ変調に関して上述したＩＦＦＴに対応する。図８に図示したＦＦＴの入力は、ＭＣＭ伝送に選択される多数のパラメタにしたがってサンプリングされる。サンプリング周波数は、地上中継器から１秒ごとに伝送されるＭＣＭシンボルの数に対応するＭＣＭシンボル周波数F_sに依存する。さらに、サンプリング周波数は、ＦＦＴ長および各ＭＣＭシンボルに関連するガードインターバル長に依存する。サンプリング周波数は、$F_4 = F_s^* FFTLEN^* (1 + GUARDLEN_REL)$であることが好ましい。ここで、ＦＦＴＬＥＮは、ＦＦＴ長（たとえば、５１２）に対応し、ＧＵＡＲＤＬＥＮ＿ＲＥＬは、有効長またはシンボル期間（たとえば、２８０マイクロ秒）

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に対するガードインターバル長に対応し、F_sは、ＭＣＭシンボル周波数に対応する。ＭＣＭシンボル周波数F_sは、１ＭＣＭシンボルあたりのビット数で割ったビットレートである。一例として、ＭＣＭ信号ビットレートは３．０６７メガビット／秒（Ｍｂｐｓ）としてもよく、１シンボルあたりのビット数は８６４または４３２としてもよい。

【００２４】

引き続き図８を参照して、約２．３ＧＨｚのＭＣＭ信号が、アンテナ１０６および低雑音増幅器（ＬＮＡ）１０８を介して無線受信機で受信され、ミクサ１１０および局部発振器１１２により約１３５ＭＨｚのＩＦにダウンコンバートされた後、ＳＡＷフィルタ１１４によって処理される。信号は、ＳＡＷフィルタ１１４により帯域制限されてエイリアシング成分を回避する。ＳＡＷフィルタの帯域幅におけるサンプリング周波数は、サンプリング信号のナイキスト基準を満たす。受信されたＭＣＭ信号は、次に、第２のミクサ１１６および第２の局部発振器１１８を用いて、約４．６０ＭＨｚの第２のＩＦにダウンコンバートされる。信号は、サンプラ１２０により、この信号の帯域幅より高い周波数、すなわち$F_2>=2*F_1$のサンプリング周波数でサンプリングされる。所要のサンプリング周波数は、図９に示すように、所望の地上信号の帯域幅に比べて高い（たとえば、所望の信号の帯域幅より４倍高い）。ブロック１２２のＡ／Ｄ変換に続いて、ディジタルフィルタ１２４を用いて隣接チャネルを抑止する。ディジタルフィルタ１２４は、隣接する衛星チャネル４６のレベルが地上信号５０より大幅に低い（すなわち、３０ｄＢのオーダで低い）ため、バンドパスフィルタに対してローパスフィルタとすることができる。隣接する衛星チャネル４６は、単に、Ａ／Ｄ変換およびダウンサンプリング後のノイズとして現れる。ディジタル低域フィルタリング後に得られるスペクトルを図１０に示す。ここで、帯域幅はF_3と等価である。次に信号には、より低いサンプリング周波数$F_4>=2*F_3$によって表されるようにダウンサンプリングが施される。周波数F_2およびF_4は、F_4が$N*F_2$に等しくなるように選択され、ここで、Ｎはたとえば４といった整数である。

【００２５】

ブロック１２６においてダウンサンプリングした後のディジタルローパスフィ

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ルタ１２４の出力は、図８に示すようにＭＣＭ復調プロセスの一部としてＦＦＴに供給される。サンプルは、シリアル－パラレル変換によりベクトルに変換され、次にＦＦＴにより周波数ドメインに変換された後、逆マッピングプロセスを介して復号される。マッピングプロセスは、複素数値を有するデータベクトルの形式のＦＦＴの出力を出力ビットストリームに変換する。

【００２６】

デュアルモード受信機

ＱＰＳＫ変調は衛星放送にとって効率のよい方法であり、一方、ＭＣＭ変調は地上放送に有効である。地方および郊外エリアに衛星放送を採用し、たとえば高層建造物により衛星信号が遮蔽される都心には地上放送を採用するシステムにおいて、衛星信号と地上信号の両方を受信するために併合受信機が必要とされる。１つの可能なデュアルモード受信機を図１１に示す。このデュアルモード受信機は、図１の無線受信機１４における衛星／地上アーム５６として利用可能である。衛星信号および地上信号が同一周波数を使用する場合、共通チューナ１２９が使用できる。デュアルモード受信機のＱＰＳＫアーム１３０およびＭＣＭアーム１３２は、図５および図８に関して上述したＱＰＳＫ復調器およびＭＣＭ復調器とそれぞれ同一にすることができる。

【００２７】

本発明の好ましい実施の形態によれば、たとえば、無線受信機の衛星／地上アームを実施するデュアルモード受信機は、ＱＰＳＫ変調とＭＣＭ復調のための複合アーキテクチャを用いて実施される。この共通アーキテクチャを図１２に示す。図１２に示すデュアルモード受信機は、１個のＳＡＷフィルタと１個のディジタルフィルタで済み、図１１に示したものに比べて受信機のコストおよび複雑性を低減するために好適である。

【００２８】

図１２を参照して、２．３３２～２．３４５ＧＨｚの範囲の周波数であることが好ましい衛星および地上信号を受信するためにアンテナ１３４およびＬＮＡ１３６が設けられる。受信された衛星および地上信号は、弱または「漏洩」ＳＡＷフィルタであることが好ましい同一のＳＡＷフィルタ１３２に供給される。前述

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したように、隣接チャネル抑止に優れている強ＳＡＷフィルタより弱ＳＡＷフィルタの方が好ましいが、これは、強ＳＡＷフィルタは、位相ひずみを招く可能性があるとともに、実施が高価であることによる。図６に示すように、弱ＳＡＷフィルタのパスバンドは、隣接チャネルにおける地上信号を僅か約６ｄＢだけ減衰する。この隣接チャネルの一部抑止は、地上信号の検出を可能にするという点で好適である。デュアルモード受信機は、地上信号が所定のしきい値を越える度に、受信された衛星信号を上回る受信された地上信号を受信機出力用に選択するように構成される。したがって、デュアルモード受信機は、本質的に地上信号を常時サーチし、地上信号が存在しない場合のみ衛星信号を選択する。

【００２９】

図示の実施の形態において、２個の電圧制御された局部発振器１４０および１４２を対応するミクサ１４４および１４６とともに、選択的に同調するスーパーヘテロダイン位相ロックループ（ＰＬＬ）１３９が設けられ、図５および図８に関して上述したように、ＱＰＳＫおよびＭＣＭ信号を２個の異なる第２のＩＦ（すなわち、それぞれ３．６８ＭＨｚと４．６０ＭＨｚ）にダウンコンバートする。たとえば、発振器１４０および１４２をともに１４．７２ＭＨｚの１つの参照発振器にロックし、２３０ｋＨｚの位相比較器周波数を使用することができる。ミクサ１４４において、周波数帯域が異なる衛星および地上信号は、異なる局部発振器入力周波数と混合され、これらの信号は約１３５ＭＨｚの同一ＩＦにダウンコンバートされる。たとえば、ミクサ入力周波数は、地上信号においてF_{LO1}が$F_{terr}-F_{IF}$、衛星信号において$F_{terr}-2.07MHz-F_{IF}$である。

【００３０】

ミクサ１４６において、サンプリング周波数は、受信機が受信機出力に地上信号を使用しているか、または衛星信号を使用しているかによって異なる。ミクサ１４６は、使用されるサンプリング周波数の１／４である第２のＩＦを達成するように再同調されることが好ましい。使用されるサンプリング周波数は、ＭＣＭ地上信号において２．３ＭＨｚの整数倍であり、ＱＰＳＫ／ＴＤＭ衛星信号において１．８４ＭＨｚの整数倍であることが好ましい。したがって、ミクサ１４６を再同調することで、Ｉ／Ｑ生成の単純化が容易になる。後述する地上検波回路

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からのフィードバックデータは、スーパーヘテロダインＰＬＬ回路１３９に供給され、十分に強力な地上信号が検出されたか否かによって、そして衛星信号の代わりに受信機出力に使用されているか否かによって、局部発振器１４０および１４２の動作を制御する。

【００３１】

図１２のディジタルフィルタ１４８は、ＱＰＳＫ復調に必要とされる整合フィルタ（たとえば、図５および図７に関して上述したＲＲＣフィルタ）の周波数応答もまた、ＭＣＭ信号をダウンサンプリングして（たとえば、サンプリング周波数$F_4 = N^* 2.3$ＭＨｚにおいて、ただしＮ＝８）ＦＦＴ処理する前に使用されるディジタルフィルタの要件を満たすように実施される。受信機がまず電源投入されると、受信機は、衛星信号を３．６８ＭＨｚの第２のＩＦにダウンコンバートするように局部発振器１４０および１４２を構成する。ブロック１５０および１５２における衛星信号のサンプリングおよびＡ／Ｄ変換は、前述の通りである。ＲＲＣフィルタにおいて、ＩＦの４倍（またはシンボルレートの８倍）のサンプリングレートが使用される。ＲＲＣフィルタのパスバンドは、当該フィルタが隣接する地上信号のエネルギーを通過させないような構成である。十分なエネルギーの地上信号が、ＳＡＷフィルタによって搬送される衛星信号に隣接するチャネル５０に存在する場合、信号エネルギーの差が、ＲＲＣフィルタの入出力間で検出できる。これは、図１２の地上信号検出器１５４により実施される。地上信号検出器１５４は、フィルタの入力側の信号エネルギーと、フィルタの出力側の信号エネルギーとを比較する。フィルタの入力側のエネルギーがフィルタ出力側に比べて非常に高い（たとえば、ＳＡＷフィルタ周波数応答にもよるが、３倍のオーダで高い）場合、地上信号が受信されていると推定される。

【００３２】

地上信号が隣接チャネルに存在する場合、地上信号検出器１５４が局部発振器１４４および１４６を再同調して地上信号をダウンコンバートすることによって信号が生成される。したがって、地上信号の中心周波数は、約２．０７ＭＨｚだけシフトされ、第２のＩＦは４．６０ＭＨｚになる。サンプリングおよびＡ／Ｄ変換に続いて、地上信号は、ＲＲＣタイプのディジタルフィルタ１４８に印加さ

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れる。ディジタルフィルタ１４８のロールオフ周波数がＱＰＳＫ復調とＭＣＭ復調の要件をともに満たすように選択され、かつ地上および衛星信号の帯域幅は同様であるため、ディジタルフィルタは、ＭＣＭ地上信号をブロック１５６に渡してダウンサンプリングした後、ブロック１５８においてＦＦＴ処理を行う。また、ディジタルフィルタ１４８の出力もサンプリングスイッチおよびラッチ素子１６０に供給され、放送局において実行されるＱＰＳＫ変調からＴＤＭ信号を再生する。次に、スイッチ１６２を用いて、サンプリングスイッチおよびラッチ素子１６０またはＦＦＴ１５８のいずれか一方から出力信号を選択し、ＴＤＭデマルチプレックスおよび復号回路１６４および検出後ダイバーシチ結合器５８（図４）を介してさらに処理する。スイッチ１６２の動作は、地上信号検出器１５４により制御される。

【００３３】

したがって、周波数プラン（図３）の下部に、衛星信号の周波数帯域４６および４８に隣接して、地上中継器周波数帯域５０および５２があることで、受信機出力に対する、衛星信号または地上信号の選択がし易くなる。隣接する地上信号の一部が、衛星信号の受信中にＳＡＷフィルタの出力に残っているため、信号パワーの比較により地上信号を検出することができる。

【００３４】

本発明を説明するために有利な実施の形態を選んできたが、添付の特許請求の範囲に記載される本発明の範囲から逸脱することなく、各種の変更および変形をし得ることが当業者には理解されるであろう。

【図面の簡単な説明】

【図１】

図１は、衛星信号および地上信号の伝送を行うディジタル放送システムを示す。

【図２】

図２は、本発明の好ましい実施の形態に係るディジタル放送システムの放送セグメントおよび地上中継器セグメントを示すブロック図である。

【図３】

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図３は、本発明の好ましい実施の形態に係るフルダイバーシチ放送システムにおける衛星信号および地上信号の周波数プランを示す。

【図４】

図４は、本発明の好ましい実施の形態にしたがって構成される衛星信号および地上信号の受信機のブロック図である。

【図５】

図５は、本発明の好ましい実施の形態にしたがって構成される１／４位相シフトキーイングされた（ＱＰＳＫ）衛星信号の受信機アームのブロック図である。

【図６】

図６は、本発明の好ましい実施の形態に係る衛星信号および地上信号の表面弾性波（ＳＡＷ）フィルタの周波数応答を示す。

【図７】

図７は、本発明の好ましい実施の形態に係る衛星信号のディジタルフィルタの周波数応答を示す。

【図８】

図８は、本発明の好ましい実施の形態にしたがって構成されるマルチキャリア変調された（ＭＣＭ）地上信号の受信機アームのブロック図である。

【図９】

図９は、本発明の好ましい実施の形態に係る表面弾性波フィルタリング後のＭＣＭ地上信号の周波数応答を示す。

【図１０】

図１０は、本発明の好ましい実施の形態に係るディジタルフィルタリング後のＭＣＭ地上信号の周波数応答を示す。

【図１１】

図１１は、ＱＰＳＫ衛星信号とＭＣＭ地上信号の両方を受信するように構成される受信機のブロック図である。

【図１２】

図１２は、本発明の好ましい実施の形態に係るＱＰＳＫ衛星信号およびＭＣＭ地上信号を受信して復調する複合アーキテクチャを有する受信機のブロック図で

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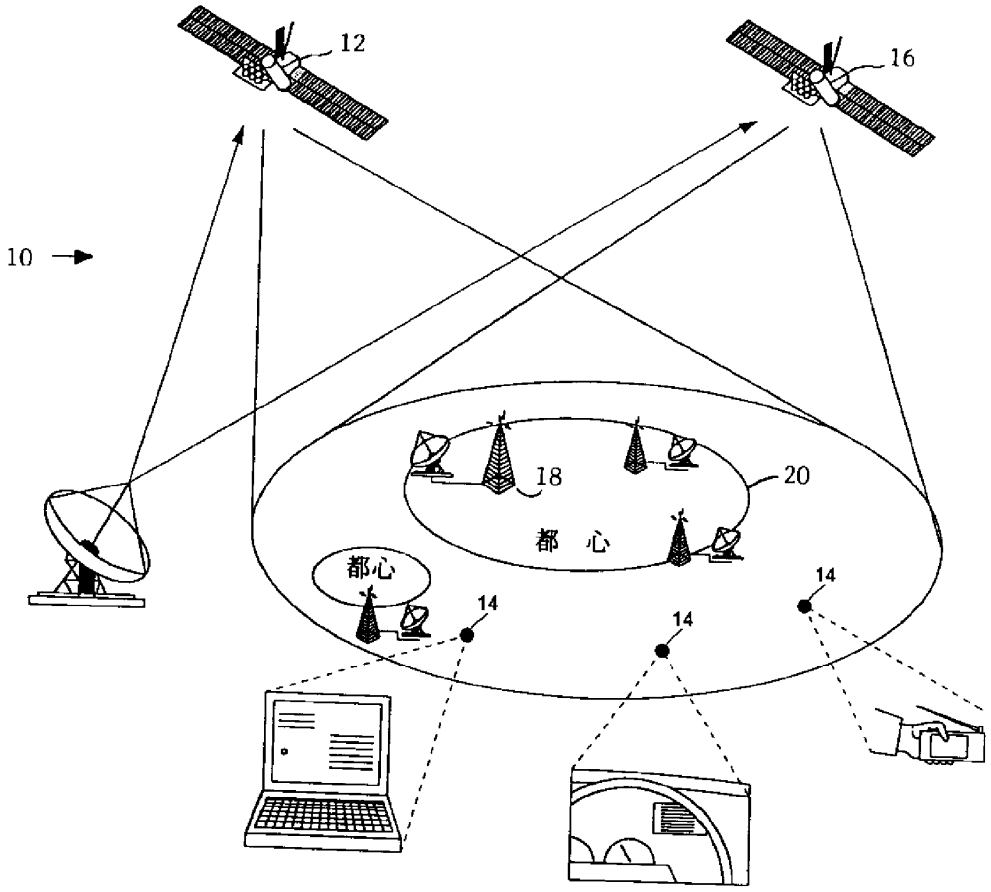
ある。

【図１】



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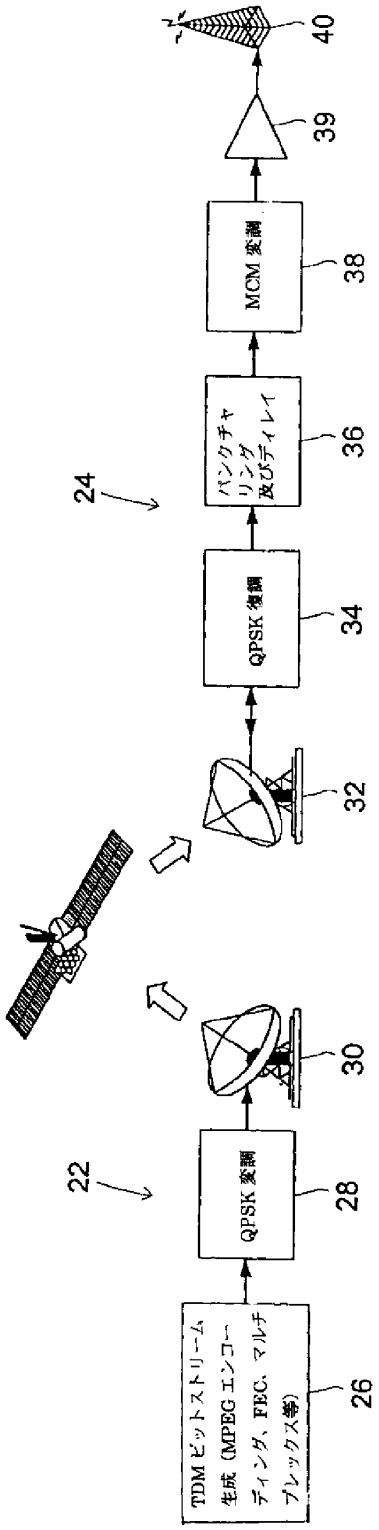
【図２】



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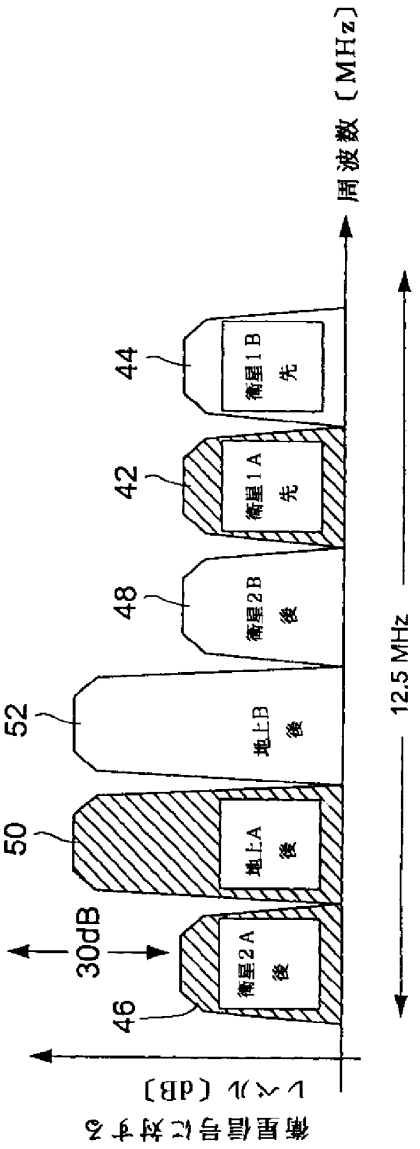
【図３】



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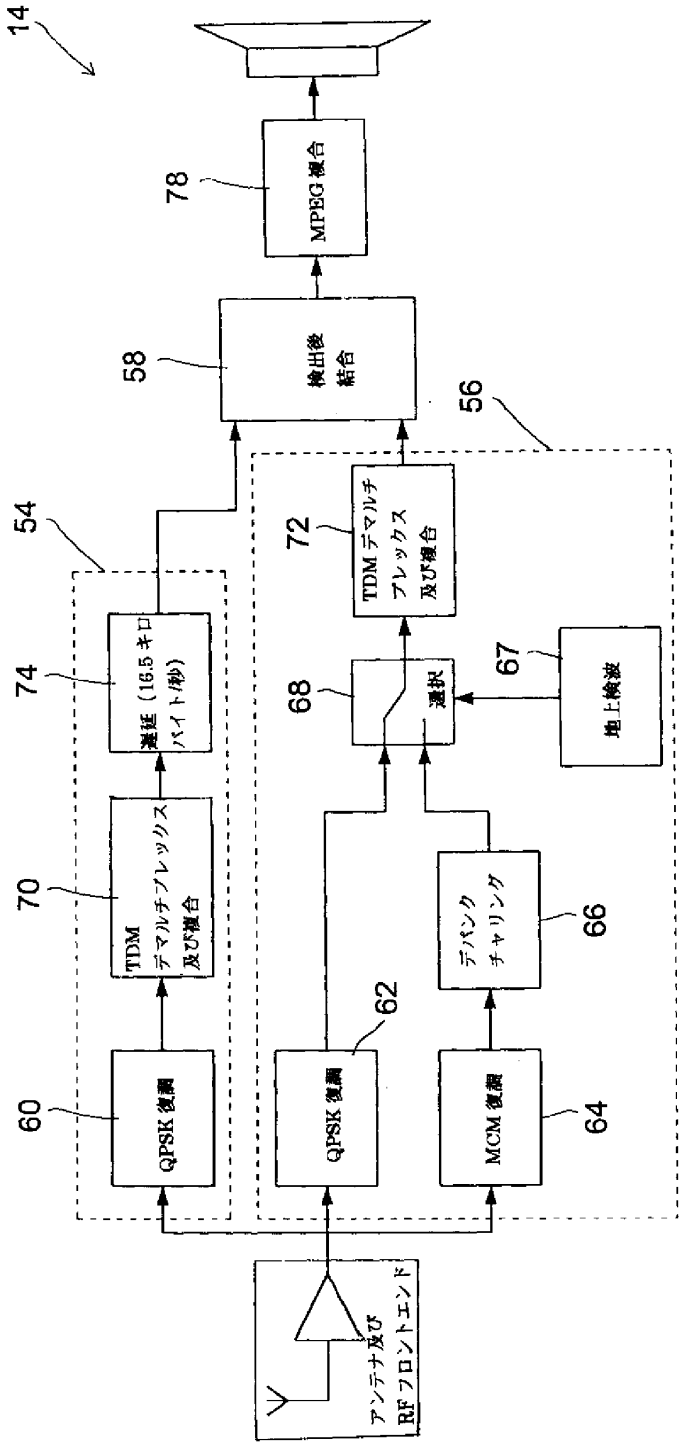
【図４】



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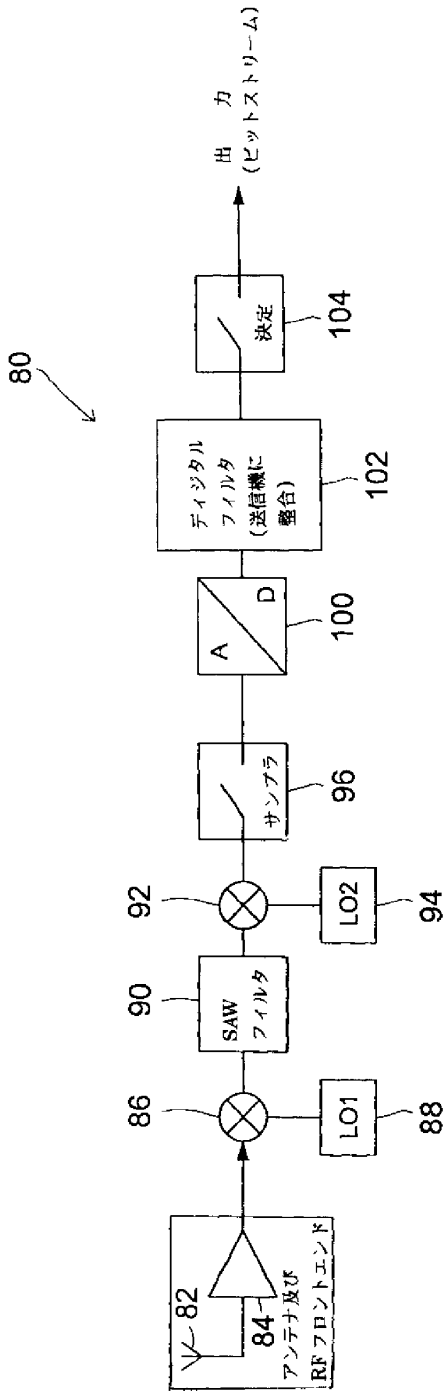
【図５】



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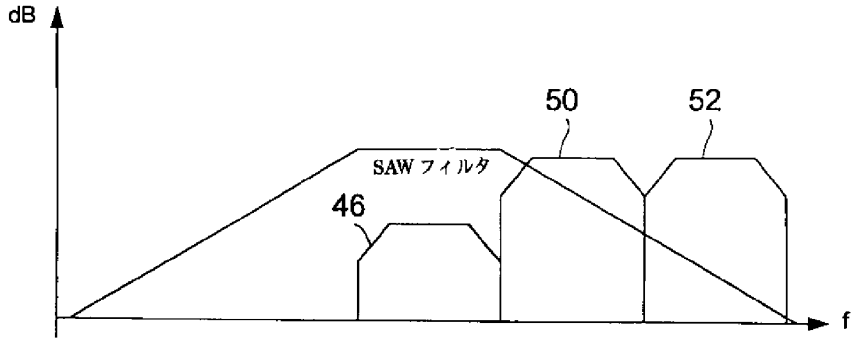
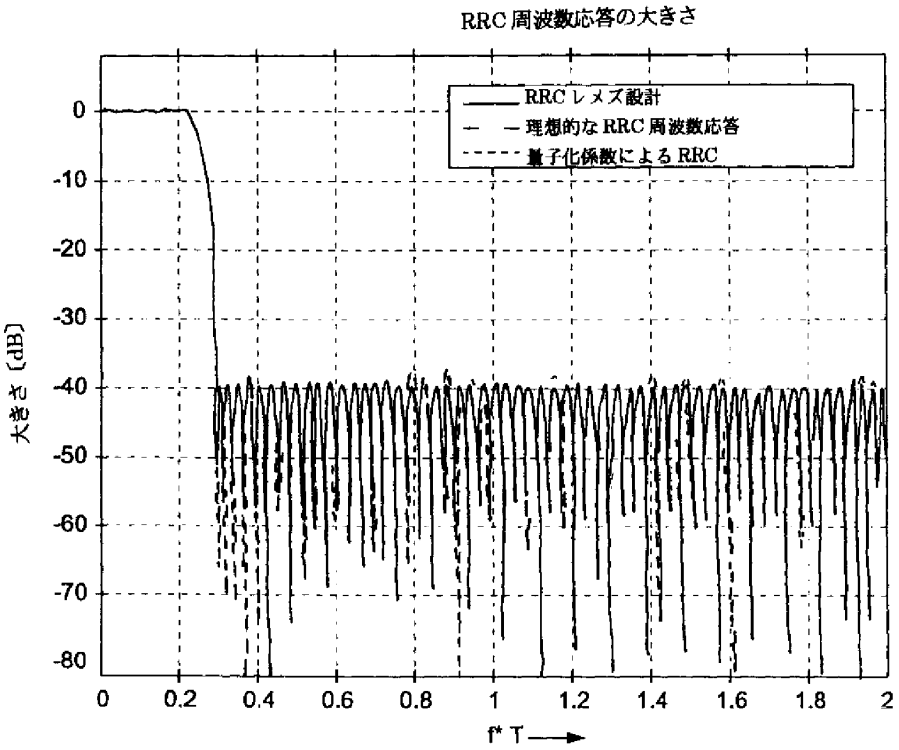
【図６】



【図７】



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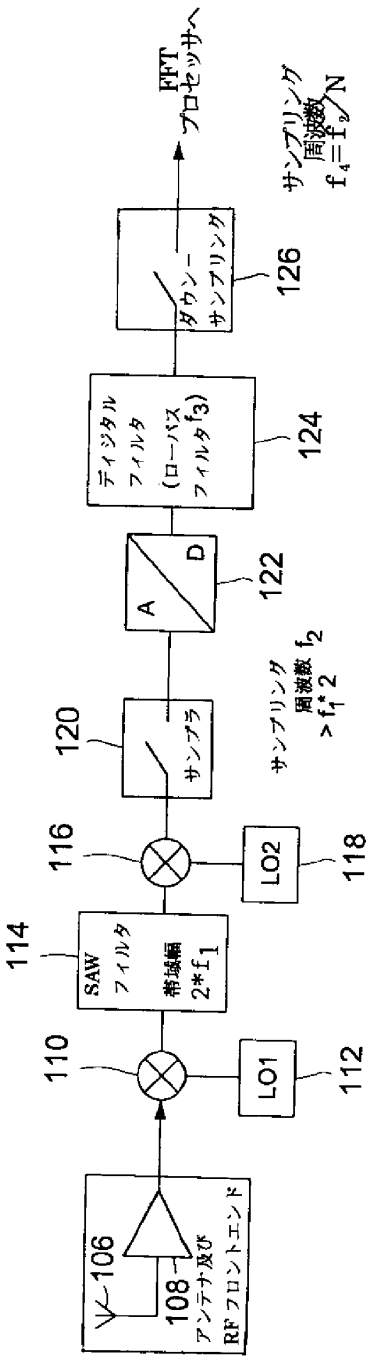
【図８】



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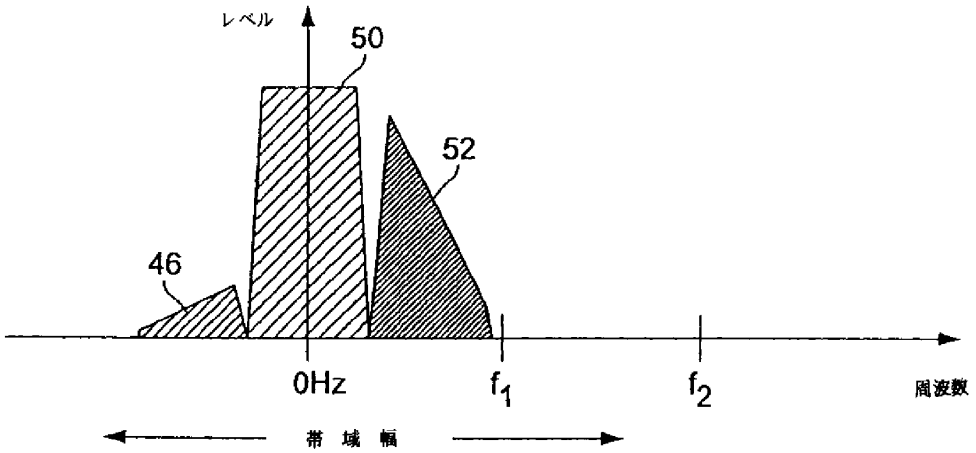
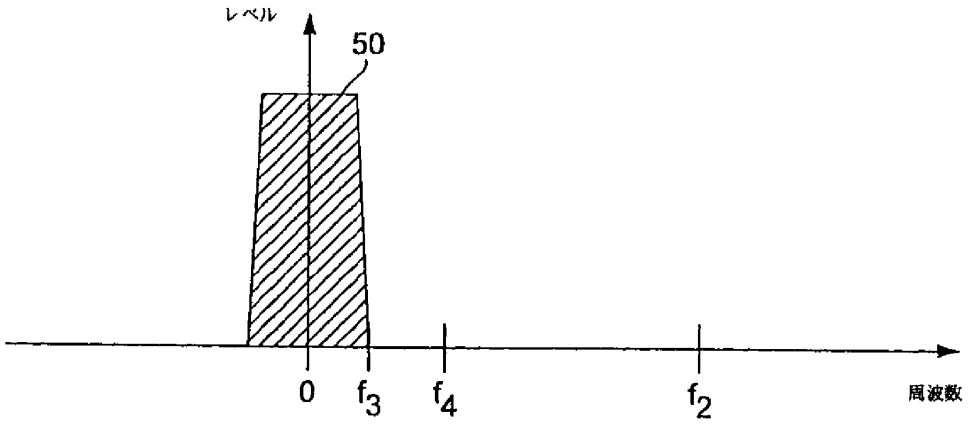
【図９】



【図１０】



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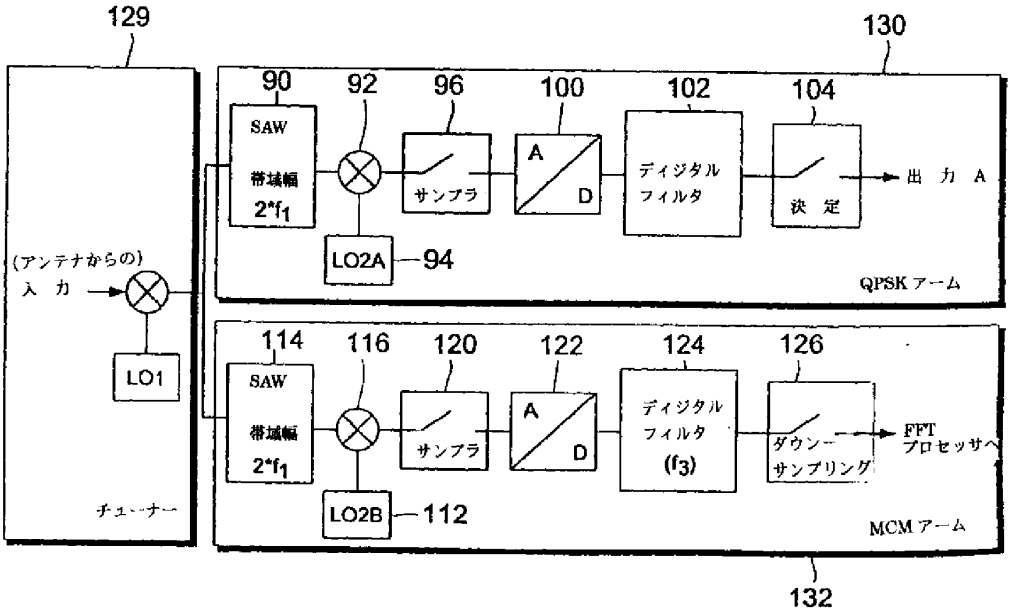
【図１１】



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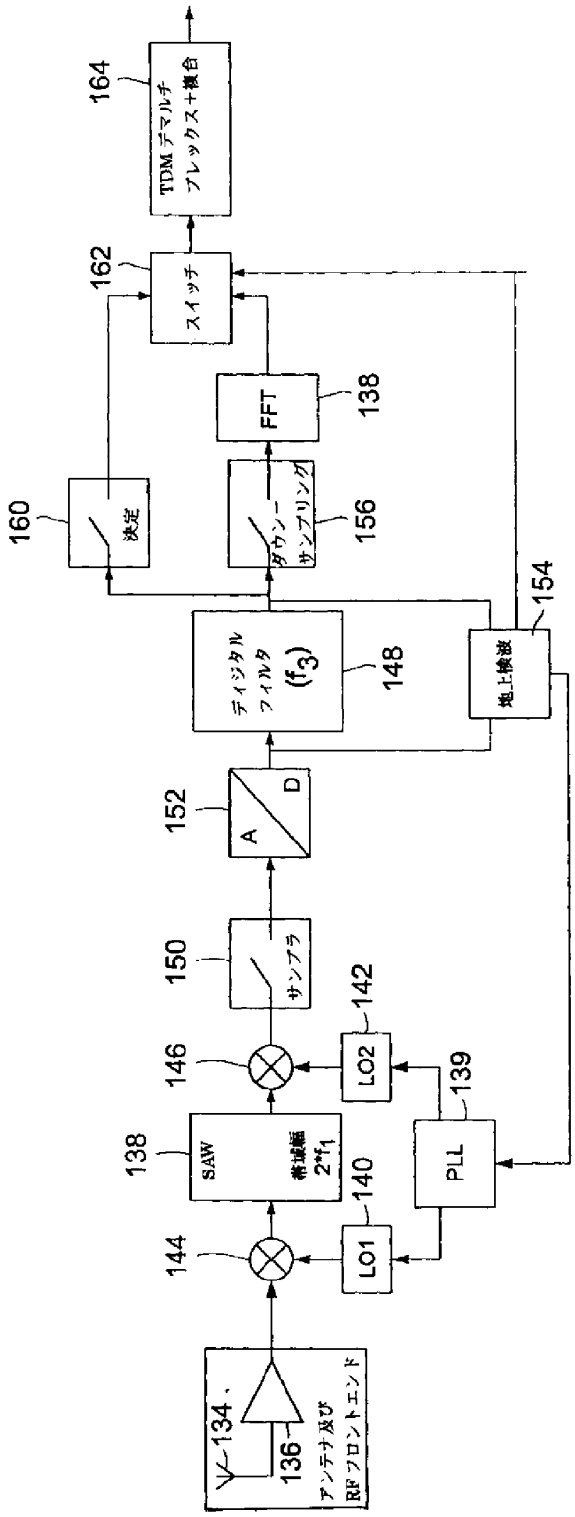
【図１２】



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【国際調査報告】

INTERNATIONAL SEARCH REPORT

Inte. ional Application No
PCT/EP 98/02168

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L27/00 H04H1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L H04H H04B H04N

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 600 672 A (OSHIMA MITSUAKI ET AL) 4 February 1997 see abstract see column 55, line 26 - line 55 see column 76, line 61 - column 78, line 6 see claim 12 see figures 138,156	1,3,6, 10,12,15
A	US 4 355 401 A (IKOMA MASAO ET AL) 19 October 1982 see abstract see column 2, line 27 - line 46 see column 4, line 29 - line 42 see figures 1,3	1,5,6, 10,15

-/--

[X] Further documents are listed in the continuation of box C. [X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 December 1998	07/12/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Simon, V

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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/EP 98/02168

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet (July 1992)

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information on patent family members

Inter nal Application No
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Personal wireless communication apparatus and method having a hearing compensation facility

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Abstract

PURPOSE: A personal wireless communication apparatus and method having a hearing sense compensation function is provided to compensate the level and characteristic of a sound provided to users according to a hearing sense characteristic of each user. CONSTITUTION: A decoding unit(10) decodes a demodulated voice signal and outputs the decoded result. A hearing sense compensating unit(12) modifies a level of the decoded result inputted from the decoding unit(10) according to a hearing sense characteristic of a user and outputs a digital voice signal having the modified level. A digital/analog converting unit(14) converts the digital voice signal outputted from the hearing sense compensating unit(12) into an analog voice signal, and provides the analog voice signal to the user.

Description

INVENTION-TITLE
BACKGROUND-ART
BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to personal wireless communication devices, such as mobile phone devices, and the like, and more particularly, to personal wireless communication devices and methods having an auditory correction function.
The main purpose of the conventional cellular phone apparatus is to transmit / receive high quality sound close to the original sound with a small amount of data. Accordingly, techniques related to vocoder—voice coder (EVC), enhanced variable rate codec (EVRC), adaptive multirate codec (AMR), and the like have been developed.
On the other hand, modern people have some hearing impairments due to environmental factors, and it is difficult to avoid obstacles such as high frequency hearing loss due to aging. In addition, some people have hearing loss due to congenital or acquired diseases. Thus, regardless of whether the user of the mobile telephone apparatus that listens to the sound is the owner of the normal hearing characteristics or the

abnormal hearing characteristics, the users have their own hearing characteristics. Here, the abnormal auditory characteristic refers to a hearing impairment in which a dynamic range of a sound that can recognize a sound is reduced, which will be described later in detail.
However, the conventional mobile phone apparatus has a problem in that a sound corresponding to the hearing characteristics of the user cannot be provided because it does not have a sound correction function according to the hearing characteristics of the user. In particular, although sound correction is essential for users who are deaf or hard of hearing due to elderly people or hearing impairments, such a conventional mobile telephone apparatus cannot provide a sound correction function.
TECHNICAL-FIELD
SUMMARY OF THE INVENTION The present invention has been made in an effort to provide a personal wireless communication device having an auditory correction function for correcting a volume and a characteristic of a sound to be provided to a user according to hearing characteristics of each user.
Another object of the present invention is to provide a personal wireless communication method having an auditory correction function performed in the personal wireless communication device.
DISCLOSURE
TECH-SOLUTION

A personal wireless communication device having an auditory correction function according to the present invention for achieving the above object includes: a decoder for decoding a digital voice signal received and demodulated from the outside and outputting a decoded result; The size of the decoded result is modified according to the user's hearing characteristics, and the digital audio signal output from the auditory corrector and the audio corrector outputting the digital speech signal having the modified size is converted into an analog voice signal. It is preferably composed of a digital to analog converter provided to the user.

In accordance with another aspect of the present invention, there is provided a personal wireless communication method having an auditory correction function, the method including decoding a digital voice signal received and demodulated from the outside, and converting the magnitude of the decoded result signal into a user's hearing characteristics. And correspondingly modifying to obtain a digital voice signal having a modified magnitude, and converting the digital voice signal having the modified magnitude into an analog voice signal and providing the same to the user.

Hereinafter, a configuration and operation of a personal wireless communication device having an auditory correction function according to the present invention and a wireless communication method performed in the device will be described with reference to the accompanying drawings.

1 is a block diagram of a personal wireless communication device having an auditory correction function according to the present invention, which includes a decoding unit 10, an auditory correction unit 12, and a digital to analog converter (DAC) 14. It consists of.

FIG. 2 is a flowchart for describing a personal wireless communication method having an auditory correction function according to the present invention performed by the apparatus shown in FIG. 1, and the method of decoding a speech signal (step 20) and the magnitude of the decoded result. Is transformed according to the auditory characteristics of the user (steps 22 to 26) and converting the modified signal into an analog signal (step 28).

First, the decoding unit 10 shown in FIG. 1 inputs and decodes a digital voice signal received and demodulated from the outside through the input terminal IN1, and outputs the decoded result to the hearing correction unit 12 (step 20).).

After the twentieth step, the hearing correction unit 12 transforms the size of the decoded result input from the decoder 10 in accordance with the hearing characteristics of the user input through the input terminal IN2, and has a digital voice having the modified size. The signal is output to the digital / analog converter 14 (steps 22 to 26).

Prior to describing the twenty-second to twenty-sixth stages, the general auditory characteristics of humans are discussed as follows.

FIG. 3 is a graph illustrating general hearing characteristics of humans, in which the vertical axis represents sound pressure and the horizontal axis represents frequency. Here, reference numeral 44 denotes a sound pressure distribution for speech, and reference numeral 46 denotes a sound pressure distribution for music.

The smallest loudness that a human can hear (HT: Hearing Threshold) and the maximum loudness (UCL: UnComfortable Hearing Level) that can cause ear pain or cause hearing problems. Is called the discomfort threshold). Here, the range between HT and UCL is called the 'sound intensity range'. In addition, audible and unpleasant thresholds vary from person to person, and these thresholds come in various forms, particularly in the case of severe hearing loss. As shown in FIG. 3, the HT 42 of the non-normal person with abnormal hearing is higher than the HT 40 of the normal person with normal hearing, and the UCL 48 of the non-normal person is higher than the UCL 50 of the normal person. Going down is a common phenomenon.

4A to 4C are graphs illustrating various auditory characteristics. FIG. 4A illustrates average hearing characteristics of a normal person, FIG. 4B illustrates average hearing characteristics of an abnormal person with conductive hearing loss, and FIG. 4C Average auditory characteristics of non-normal persons with sensorineural loss are shown. 4b to 4c, the dotted line represents the normal HT of the normal user, and the solid line represents the HT of the normal or abnormal user and the back sensory level (the sound pressure for each frequency detected by the user with the same loudness in the form of a contour line). Represent each.

The hearing characteristics of the abnormal user having the conductive hearing impairment shown in FIG. 4B are increased compared to the normal user shown in FIG. 4A, and the contours of the same shape as in the normal case are maintained for each frequency and sound pressure. . In the case of conductive hearing loss, the distortion of sound according to frequency is small and it is difficult to hear the sound in the entire frequency range. On the other hand, the HT and the sensory level for each frequency and sound pressure of the non-normal user with the aural hearing loss shown in FIG. 4C show an example in which hearing ability is lost in the high frequency region compared to the normal person. In this case, compensation according to frequency is required, and the present invention is particularly effective for auditory compensation in this case.

Therefore, the hearing correction unit 12 shown in FIG. 1 performs the twenty-second to twenty-sixth steps, and the personal wireless communication device has a dynanmic range of sound that can be heard by the user for each frequency. Transform according to the user's hearing characteristics. For example, the hearing correction unit 12 may convert the intensity range 60 of a sound that can be heard by a normal user into the intensity range 62 of a sound that can be heard by an abnormal user, as shown in FIG. 4C for a 4 KHz frequency signal. It transforms. Here, the deformation that reduces the intensity range of the sound, which is the input signal, from 60 to 62 is referred to as 'compression'.

The twenty-second through twenty-sixth steps performed by the auditory corrector 12 shown in FIG. 1 will be described below with reference to the accompanying drawings.

FIG. 5 is a block diagram of a preferred embodiment of the auditory correction unit 12 shown in FIG. 1 according to the present invention, and includes first to Mth band pass filters (BPFs) 72, 74,. And a filter bank 70 comprising 76, a unit 80 composed of first to Mth signal converting units 82, 84, ..., and 86, and a signal synthesizing unit 90.

First, after the twentieth step, the band pass filters 72, 74, ..., and 76 of the filter bank 70 may decode the decoded result input from the decoder 10 through the input terminal IN3 for each desired frequency band. The filtered results are output to the first to Mth signal converters 82, 84,... And 86 as first to Mth band

signals (step 22). For example, the m th (1 m M) band pass filter 72, 74,... Or 76 filters the decoded result in the desired m th frequency band and filters the filtered result as the m th band signal. The signal is output to the signal converters 82, 84, ... or 86. Here, the number M of band pass filters may be 4 to 8, and each band pass filter may be implemented as an octave band filter. At this time, M and the width of each band pass filter may be fixed. As described above, the reason for filtering the decoded result for each desired frequency band is to adjust the gain of the decoded result differently for each frequency band, since a user's hearing abnormality or auditory difference generally appears different for each frequency.

After the twenty-second step, the unit 80 consisting of the first to Mth signal converting units 82, 84,..., And 86 measures the magnitude of each of the first to Mth band signals, and measures the magnitude. Each of them is transformed in correspondence to the user's auditory characteristics input through the input terminal IN2, and the band signals having the modified magnitudes are output to the signal synthesis unit 90 as the first to Mth transform band signals (step 24).). For example, the m-th signal converter 82, 84, ... or 86 measures the magnitude of the m-th band signal, transforms the measured magnitude corresponding to the auditory characteristics input through the input terminal IN2, The m th conversion band signal having the magnitude is output to the signal synthesizing unit 90.

The configuration and operation of a preferred embodiment according to the present invention of each signal converter 82, 84, ..., or 86 shown in FIG. 5 will be described below.

FIG. 6 is a block diagram of an exemplary embodiment of the m-th signal converter shown in FIG. 5 and includes a signal measuring unit 100 and a gain controlling unit including a size measuring unit 106 and a size determining unit 108. 102 and the amplifier 104.

FIG. 7 is a flowchart illustrating an operation according to an exemplary embodiment of the present invention for generating an m-th conversion band signal in the m-th signal converter shown in FIG. 5, and measuring the magnitude of the m-th band signal. Step (120), adjusting the measured magnitude (122-130) and changing the gain of the m-th band signal corresponding to the adjusted magnitude and auditory characteristics (step 132 and 134). S).

First, after the twenty-second step, the signal magnitude adjusting unit 100 of the m-th signal converter 82, 84,..., Or 86 shown in FIG. 6 passes through the m-th BPF 72, 74,. .. or 76) measure the magnitude of the m-th band signal input from the sensor, detect whether the measured magnitude of change is large, and gradually increase or decrease the magnitude of the m-th band signal in response to the detected result. To the gain control unit 102 (steps 120 to 130).

Here, the role of the signal amplitude adjusting unit 100 will be described.

Even if the signal amplitude adjusting unit 100 shown in FIG. 6 is not provided, the sound is moderately loud when the volume of the sound provided to the user by the hearing correction unit 12 is small, and the sound is too loud when the loudness of the sound is too large. Decreases moderately. However, when the magnitude of the signal suddenly increases or decreases suddenly, a very loud sound or a very small sound may be output. That is, when a small sound corresponding to the input signal suddenly changes loud, a signal having a magnitude smaller than that of the input signal should be output. However, in this case, suddenly reducing the loudness may reduce the distinction of the language, and also, if the instantaneous loudness is a meaningful sound, for example, a necessary car horn, such a meaningful sound may be properly presented to the user. Problems failing to deliver. In order to solve these problems, the signal amplitude adjusting unit 100 described above is provided.

To this end, the size measuring unit 106 of the signal size adjusting unit 100 shown in FIG. 6 measures the size of the m-th band signal input from the m-th BPF through the input terminal IN4 after the twenty-second step, and measures the measured size. Is output to the size determining unit 108 (step 120).

8A and 8B are graphs showing the input and output of the magnitude measuring unit 106, and FIG. 8A shows an exemplary waveform diagram of the 20K sampled m-band signal input to the magnitude measuring unit 106, and FIG. 8B Represents the magnitude of the m-th band signal output from the magnitude measuring unit 106, that is, the envelope, and the horizontal axis represents time n, and the vertical axis represents the magnitude of the m-th band signal. .

According to a preferred embodiment of the present invention, the magnitude measuring unit 106 measures the envelope of the m-th band signal shown in FIG. 8A as the magnitude, and measures the measured magnitude shown in FIG. 8B as the magnitude determining unit 108. You can print However, calculating the envelope accurately requires a lot of computation and results in time-delayed results. Therefore, according to another exemplary embodiment of the present invention, the magnitude measuring unit 106 measures an absolute value instead of an envelope of the m-th band signal, and measures the absolute value as the measured magnitude of the m-th band signal. Or output to 108. Therefore, the magnitude measuring unit 106 can effectively measure the magnitude of the m-th band signal despite a small amount of calculation.

After step 120, the size determiner 108 measures the sample size [A (n)] measured at a certain sample time n by the size measuring unit 106 with respect to the m-th band signal (n-1).) Is compared with the magnitude [A (n-1)], and the magnitude of the m-th band signal is gradually increased or decreased in response to the comparison result, and is output to the gain control unit 102 (122-130). Steps).

FIG. 9 is a block diagram of a preferred embodiment of the size determining unit 108 shown in FIG. 6 according to the present invention. The first and second buffers 150 and 156, the comparing unit 152, and the first and second buffers are shown. Two selectors 154 and 166, first and second multipliers 158 and 162, a subtractor 160 and an adder 164.

10A and 10B show waveform diagrams of signals input to the filter bank 70 shown in FIG. 5, and FIG. 10B shows waveform diagrams of signals output from the signal combiner 90 shown in FIG. 5, respectively.

The first buffer 150 illustrated in FIG. 9 inputs and buffers the size A measured by the size measuring unit 106, and outputs the buffered result to the comparator 152. Therefore, when A (n) is input to the first buffer 150, the buffered result output from the first buffer 150 becomes A (n-1). At this time, the comparator 152 measures the size A (n) measured by the size measuring unit 106 at a certain sample time n for the m-th band signal at a sample previous time n-1. It is determined whether the first threshold value Th1 is larger than the size A (n-1), which is the result of being buffered in the first buffer 150, and the determined result is a result of detecting the degree of change of the measured size. In operation 122, it is output. That is, in step 122, the comparator 152 determines whether the size measured by the size measuring unit 106 has suddenly increased. For example, it is determined whether the measured magnitude [A] has suddenly increased from A (a) to A (b).

11 (a) and 11 (b) are waveform diagrams for explaining the first predetermined attack time and the second predetermined release time, and FIG. 11 (a) shows the filter bank shown in FIG. 70 is a timing diagram showing a signal input in the form of a square wave, and FIG. 11B is a timing diagram showing a signal output from the signal synthesizing unit 90 shown in FIG. 5 in the form of a square wave.

If the magnitude A (n) 182 measured as shown in FIG. 10A is greater than or equal to A (n-1) 180 by the first threshold Th1, the magnitude of the signal as shown in FIG. 10B. [A (n)] is gradually reduced, and an m-th band signal having a finally determined magnitude [Mag (n)] expressed as in Equation 1 is obtained, and the flow proceeds to step 132 (step 124).

[1]

Here, the predetermined attack time T .sub.r is smaller than the level 190 when the magnitude of the m-th band signal finally decreases as shown in FIG. 11B with respect to the magnitude measured by the magnitude measuring unit 106. It means the time required to reach the level 192 as high as the first predetermined level. Here, the level 190 corresponds to the level when the output of the size determining unit 108 is stabilized. The first predetermined level may be 2 dB as shown in FIG. 11 (b).

However, the comparator 152 determines that if A (n) is not greater than the first threshold Th1 greater than A (n-1), then A (n) is greater than the second threshold Th2 than A (n-1). It is determined whether or not the error is small (step 126). That is, the comparator 152 determines whether the size measured by the size measuring unit 106 is sharply reduced. For example, it is determined whether the measured size [A] has changed from A (b) to A (a) as shown in FIG. 10A. If A (n) 186 is less than a second threshold Th2 than A (n-1) 184 as shown in FIG. 10A, the measured size [A] as shown in FIG. (n)] is gradually increased to obtain the m-th band signal having the finally increased magnitude [Mag (n)] represented by Equation 2, and proceeds to step 132 (step 128).

[2]

Here, the predetermined release time T .sub.f is lower than the level 194 when the magnitude of the m-th band signal is finally increased as shown in FIG. 11B with respect to the magnitude measured by the magnitude measuring unit 106. 2 means the time required to reach the level 196 as low as a predetermined level. Here, the level 194 corresponds to the level when the output of the size determining unit 108 is stabilized. The second predetermined level may be 2 dB as shown in FIG. 11 (b).

In order to perform steps 124 and 128, the size determiner 108 may include a first selector 154, first and second multipliers 158 and 162, a subtractor 160, and an adder 164.) And the second buffer 156 may be provided.

Here, the first selector 154 selectively outputs one of the predetermined attack time T .sub.r or the predetermined release time T .sub.f in response to the comparison result of the comparison unit 152. That is, when it is determined that A (n) is greater than A (n-1) by the first threshold value Th1 based on the result compared by the comparator 152, the first selector 154 may determine a predetermined attack time (T .sub.r) is selected and output, and when it is determined that A (n) is less than or equal to A (n-1) by the second threshold Th2, the predetermined release time T .sub.f is selected and output. At this time, the first multiplier 158 multiplies the result buffered by the second buffer 156 [Mag (n-1)] and the output of the first selector 154 and adds the multiplied result to the adder (164). The subtractor 160 subtracts the output of the first selector 154 from a predetermined value, for example, '1', and outputs the subtracted result to the second multiplier 162. The multiplier 162 multiplies the output of the subtractor 160 by the output A (n) of the size measuring unit 106, and outputs the multiplied result to the adder 164. The adder 164 adds the results multiplied by the first and second multipliers 158 and 162, and adds the added result to the size represented by the above-described equation (1) or 2, which is varied at the sample time (n). Mag (n)]. At this time, the second buffer 156 buffers the output of the adder 164 and outputs the buffered result Mag (n-1) to the first multiplier 158.

Meanwhile, according to one preferred embodiment of the present invention, if A (n) is determined not to be less than or equal to the second threshold Th2 than A (n-1), that is, the level of A (n) is A (If it is determined that it is not suddenly larger or abruptly smaller than the level of n-1), the magnitude [Mag (n-1)] which is finally larger or smaller at one sample previous time (n-1) is determined by which sample time (Finally, in step n), it is determined as the larger or smaller size Mag (n) and the process proceeds to step 132 (step 130). To this end, the size determiner 108 responds to the output of the adder 164 or one of the results buffered in the first buffer 150 [A (n-1)] in the comparison unit 152. In addition, a second selector 166 may be further provided to the gain control unit 102 and output as Mag (n). That is, the second selector 166 may have A (n) less than or equal to A (n-1) by the second threshold value Th2 or the first threshold value Th1 based on the result of comparison by the comparator 152. If it is determined to be large, the output of the

adder 164 is selected and output to the gain controller 102. However, the second selector 166 does not have A (n) greater than A (n-1) or more than the first threshold value Th1 through the result of comparison by the comparator 152, and A (n) If it is determined that the second threshold Th2 is not less than A (n-1), the result buffered in the first buffer 150 [Mag (n-1)] is output to the gain controller 102.

According to another preferred embodiment of the present invention, when A (n) is determined to be no more than the second threshold Th2 less than A (n-1), that is, the level of A (n) is A (n) When it is judged that it is not suddenly larger or abruptly smaller than the level of -1), the measured magnitude [A (n)] is varied as in Equation 1 or 2 above, and the variable magnitude [Mag (n) The signal having] may be output to the gain control unit 102. In this case, the size determiner 108 does not need to provide the second selector 106 shown in FIG. That is, the first selector 154 of the size determiner 108 does not increase the level of A (n) more rapidly than the level of A (n-1) through the result of comparison in the comparator 152. If it is determined that it is not suddenly small, any one of the predetermined attack time T .sub.r and the predetermined release time T .sub.f can be selectively output.

On the other hand, in step 124, 128, or 130, the size of the m-th band signal is varied using the magnitude [Mag (n)] and auditory characteristics of the m-th band signal output from the size determining unit 108; The m th band signal having the variable size is determined as the m th conversion band signal, and the flow proceeds to step 26 (steps 132 and 134). To this end, the gain control unit 102 shown in FIG. 6 generates an agent generated by using the magnitude (Mag (n)) of the m-th band signal output from the signal amplitude adjusting unit 100 and the auditory characteristics input through the input terminal IN2. The m gain control signal is output to the amplifier 104 (step 132). Here, the m-th signal converter may not provide the signal amplitude adjusting unit 100 unlike in FIG. 6, in which case, the m-th band signal input through the input terminal IN4 is directly applied to the gain controller 102. do. Therefore, instead of inputting the magnitude [Mag (n)] of the m-th band signal output from the signal magnitude adjusting unit 100, the gain control unit 102 receives the m control unit from the m-th BPF 72, 74, ... or 76. The m-th gain control signal may be generated by directly inputting the m-band signal and using the magnitude of the input m-th signal and the auditory characteristics input through the input terminal IN2. At this time, the amplifier 104 varies the magnitude of the m-th band signal input through the input terminal IN4 in response to the m-th gain control signal output from the gain control unit 102, and the m-th band having the variable size. The signal is output to the signal synthesis unit 90 through the output terminal OUT3 as the m th conversion band signal (step 134).

Meanwhile, the band signal compression process according to the present invention performed in steps 132 and 134 will be described in detail as follows.

12 is a graph illustrating a band signal compression process according to the present invention, where the horizontal axis represents the magnitude Xm of the signal input to the gain control unit 102 and the vertical axis represents the magnitude of the signal output from the gain control unit 102. (Ym) is shown. Here, the dotted line portion of the curve 212 represents the actual auditory characteristic for the abnormal user, and the solid line portion represents the approximate auditory characteristic for the abnormal user.

Assume that each HT and UCL of the normal user 210 and the deaf user 212 having a hearing impairment in the m th frequency band is given as shown in FIG. 12. At this time, the gain control unit 102 and the amplifier unit 104 inputs an input signal having an amplitude Xm within the dynamic range 214 of the normal user according to an auditory characteristic input through the input terminal IN2. It compresses and outputs a signal having a magnitude Ym in the dynamic range 216. Here, the auditory characteristic is composed of knee points A1, A2, A3, A4, A5 and A6 shown in FIG. The knee point corresponds to a point on the X and Y coordinates where the X-axis is the magnitude of the m-th band signal or the output of the size determining unit 108, and the Y-axis is the magnitude of the m-th conversion band signal. Here, A1 represents the HT of the abnormal user corresponding to the HT of the normal user, A5 represents the UCL of the abnormal user corresponding to the UCL of the normal user, and A2, A3 and A4 represent characteristics of the intermediate stage, respectively. In FIG. 12, five knee points were used to show auditory characteristics.

However, taking into account the shape and complexity of the auditory characteristic curve 212 shown in FIG. 12, the number of knee points can be determined. The number of preferred knee points is generally about 3-4.

The gain control unit 102 shown in FIG. 6 uses the knee points A1, A2, A3, A4 and A5, which input the magnitude of the signal Xm input from the size determining unit 108 through the input terminal IN2. Interpolation, and there may be various interpolation methods. One of the interpolation methods, the linear interpolation method, is as follows.

In the linear interpolation method, the gain controller 102 linearly connects the input knee points to generate a solid line portion of the curve 212 illustrated in FIG. 12, that is, an approximated auditory characteristic curve of an abnormal user. At this time, when an input signal having a magnitude Xm between HT and UCL shown in FIG. 12 is input, the gain control unit 102 outputs an output Y (Xm) corresponding to the magnitude of the input signal Xm. Find using the solid line portion of curve 212.

FIG. 13 is a graph illustrating a band signal compression process according to the present invention, in which the horizontal axis represents the magnitude Xm of the signal input to the gain control unit 102 and the vertical axis represents the magnitude of the signal output from the gain control unit 102. (Ym) is shown, respectively.

For example, it is assumed that the level Xm of the signal input to the gain control unit 102 exists between HT and B2 as shown in FIG. At this time, the gain control unit 102 obtains an output signal [Y (HT)] suitable for the user's auditory characteristic when Xm is HT, and output signal [Y (B2)] suitable for the user's auditory characteristic when Xm is B2.], And when Xm is a value between HT and B2, an output signal [Y (Xm)] suitable for the user's hearing characteristics is obtained. The gain control unit 102 outputs the m-th gain control signal corresponding to the output signal Y (HT), Y (B2) or Y (Xm) to the amplifier 104. At this time, the amplifier 104 controls the gain Gm of the m-th band signal input through the input terminal IN4 in response to the m-th gain control signal, and the gain is controlled [Y (HT), Y (B2) or Y (Xm)] is output as the m th conversion band signal through the output terminal OUT3.

As a result, in steps 132 and 134, the knee points A1 to A5 are inputted from the outside, and they are linearly connected, and from the connected line segment, the general equation Ym = sXm + I (where s means slope, I denotes the intercept of the Y axis.) And Ym corresponding to the corresponding Xm from the general equation.

After the twenty-fourth step, the signal synthesizing unit 90 synthesizes the first through the M-th conversion band signals output from the first through the M-th signal converters 82, 84,. Is outputted to the digital / analog converter 14 through the output terminal OUT2 (step 26).

After the twenty-sixth step, the digital voice signal having the modified magnitude output from the hearing correction unit 12 which is a result synthesized by the signal synthesizer 90 is converted into an analog voice signal by the digital / analog converter 14, The converted analog voice signal is provided to the user through the output terminal OUT1 (step 28).

On the other hand, according to an embodiment of the present invention, the auditory compensation unit 12 may be directly applied to the auditory properties previously obtained from the outside. According to this embodiment, when the user has severe hearing loss, the personal wireless communication device according to the present invention can correct the band signal by using the ideal auditory characteristics accurately measured in an external auditory laboratory equipped with all the equipment. . In this case, the auditory characteristic may be directly applied to the hearing correction unit 12 through an external interface (not shown), which will be described later, and the hearing correction unit 12 may be directly operated by a user directly operating a key of the key input unit (not shown). May be applied to.

According to another exemplary embodiment of the present invention, the hearing compensator 12 may receive an auditory characteristic determined by a user by listening to sounds corresponding to a plurality of auditory characteristics previously given and stored from the outside. To this end, the personal wireless communication device according to the present invention shown in FIG. 1 is one of a plurality of auditory characteristics stored in a storage unit (not shown) and a storage unit (not shown) for inputting and storing a plurality of auditory characteristics from the outside. May further include a selection unit (not shown) for selectively outputting the signal in response to the selection signal. Here, each auditory characteristic (1, 2, 3, 4, 5, 6, ... n ') in the auditory characteristic table stored in the storage unit (not shown) are the knee points A1 and A2 as shown in Table 1 below. , A3, A4 and A5).

Auditory Characteristics Selection Auditory characteristic variables F1 = 500 Hz F2 = 1000 Hz F3 = 2000Hz FM = XHz A1 A2 A3 A1 A2 A3 A1 A2 A3 A4 A5 A1 A2 A3 A4 One 23 133 576 66 154 877 45 534 1242 3455 4568 10 30 53 100 2 32 132 867 56 245 987 55 345 1424 3453 6758 20 40 167 238 3 34 124 978 76 134 677 67 353 1342 3545 6865 20 45 176 567 4 65 145 567 87 276 566 46 465 1423 3453 6786 14 42 156 865 5 78 156 978 78 145 867 54 355 1234 3453 6866 15 56 276 348 6 56 187 896 98 186 866 46 322 1234 3453 8666 17 23 187 297 n ' 76 167 987 78 228 867 35 214 1244 3533 7455 20 54 287 345

In Table 1, each of F1, F2, ..., and F (M) represents the center frequency of each frequency band. At this time, the user determines a selection signal by listening to sounds corresponding to a plurality of auditory characteristics stored in a storage unit (not shown), so that the corresponding auditory characteristic is applied to the auditory correcting unit 12 through the input terminal IN2. . Here, the process of obtaining the auditory characteristic table shown in Table 1 will be described.

Investigating the auditory characteristics of general users can be classified into several categories. For example, auditory characteristics can be broken down by age or user's environment. That is, the elderly have hearing characteristics with high frequency hearing loss and narrow dynamic range, those who are frequently exposed to a certain kind of noise show similar hearing characteristics, and those who frequently listen to music through headphones and the like are similar to each other. Hearing characteristics. Thus, using this phenomenon, several representative auditory characteristics can be obtained as shown in Table 1.

In this case, the user selects an auditory characteristic suitable for the user from among several auditory characteristics pre-stored in the storage unit (not shown) and provides the auditory characteristic to the personal wireless communication device according to the present invention. That is, the user is sequentially provided with a standard voice signal corresponding to several stored auditory characteristics, and the user selects an auditory characteristic suitable for the user through the multiple standard voice signals, and selects the selected auditory characteristic for the individual according to the present invention. Applied to a wireless communication device.

According to still another preferred embodiment of the present invention, the personal wireless communication device according to the present invention may further include an auditory characteristic tester (not shown) which inspects the auditory characteristic of the user by itself. This makes it possible to simply check the hearing characteristics of the user himself of the mobile telephone apparatus when the personal radio communication apparatus according to the present invention is applied to the mobile telephone apparatus. In this case, the auditory characteristic inspector (not shown) may be built in the auditory corrector 12 or may be separately provided outside the auditory corrector 12. In addition, the auditory characteristic test performed by the auditory characteristic inspector (not shown) is performed only once before performing the twenty-fourth step illustrated in FIG. 2 and continues to use the inspected result until the auditory characteristic of the user is changed.

Hereinafter, a configuration and an operation of an auditory characteristic test method and an auditory characteristic test unit (not shown) according to the present invention will be described with reference to the accompanying drawings.

FIG. 14 is a flowchart illustrating an auditory characteristic checking method according to the present invention, in which a first frequency band is selected (steps 240 and 242) when an auditory characteristic is required, and an audible threshold for a corresponding frequency band (Steps 244 to 250), determining a knee point for the corresponding frequency band (steps 252 to 256), and determining a discomfort threshold for the corresponding frequency band (step Steps 258 to 262) and determining corresponding other frequency bands (steps 264 and 266).

FIG. 15 is a block diagram of a preferred embodiment of the auditory characteristic inspecting unit according to the present invention for performing the auditory characteristic inspecting method shown in FIG. 14. The first, second, and third knee point determination units 280, 282 and 284 and a control unit 286.

First, the controller 286 continuously determines whether an auditory inspection request signal for requesting auditory characteristics examination is input from the outside through the input terminal IN6, and generates the determined result as a control signal (step 240). If measurement of the auditory characteristic is required from the outside, the first frequency band is selected from the first to Mth frequency bands (step 242). To this end, when the first knee point determiner 280 recognizes that the auditory characteristic is requested from the outside through a control signal generated from the controller 286, the first knee point among the first to Mth frequency bands is determined. The test signal corresponding to is input through input terminal IN5. Here, the test signal corresponds to a pure tone signal corresponding to the center frequency of the m-th frequency band or a complex signal in which frequency components within the m-th frequency band are added together.

After operation 242, the first knee point determiner 280 determines an audible threshold of the m-th frequency band, and outputs a knee point A1 corresponding to the determined audible threshold (steps 244 to 250). field).

To this end, after step 242, the first knee point determiner 280 generates a test signal having a predetermined minimum magnitude input through the input terminal IN5 through the output terminal OUT4 (step 244). After operation 244, the user determines whether a sound corresponding to the test signal output through the output terminal OUT4 can be heard (operation 246). If the user cannot hear the sound, the test signal is increased in magnitude by a third predetermined level and the flow proceeds to step 246 (step 248). That is, when it is determined that the user cannot hear the sound through the first state signal input through the input terminal IN7, the first knee point determiner 280 increases the size of the test signal by a third predetermined level and increases it. The new test signal with the set level is output again through the output terminal OUT4. Accordingly, the user determines whether a sound corresponding to the new test signal can be heard and applies the determined result to the first knee point determiner 280 through the input terminal IN7 as the first state signal. However, when it is determined that the user can hear the sound through the first state signal input through the input terminal IN7, the first knee point determiner 280 determines the size of the test signal corresponding to the sound as an audible threshold. In operation 250, the knee point A1 corresponding to the audible threshold value is output.

After operation 250, the second knee point determiner 282 determines the knee point of the m-th frequency band providing a comfortable feeling to the user, and outputs the determined knee point A3 (steps 252 to 256).).

To this end, after step 250, the user determines whether the sound corresponding to the test signal output through the output terminal OUT5 provides a comfortable feeling (step 252). If the sound corresponding to the test signal does not provide a comfortable feeling, the test signal is increased in magnitude by the fourth predetermined level and the process proceeds to step 252 (step 254). That is, when it is determined that the user cannot feel comfortable through the second state signal input through the input terminal IN8, the second knee point determiner 282 increases the magnitude of the test signal by a fourth predetermined level. , Output a new test signal with increased level through output terminal OUT5. Accordingly, the user determines whether the sound corresponding to the new test signal provides a comfortable feeling, and

applies the determined result to the second knee point determiner 282 as a second state signal through the input terminal IN8. However, when it is determined that the user is provided with a comfortable feeling in response to the second state signal input through the input terminal IN8, the second knee point determiner 282 may test the test signal corresponding to the sound providing the comfortable feeling. The knee point A3 determined by using the size of P is output (step 256). Here, the second knee point determination unit 282 may include the knee point A2 corresponding to a sound slightly smaller than the sound corresponding to the knee point A3 determined in step 256 and the knee point A4 corresponding to a slightly louder sound. May be further determined further. However, clinically determining five or more knee points is less meaningful and difficult to measure. Therefore, three needle points (A1, A3 and A5) are preferable.

After operation 256, the third knee point determination unit 284 determines the knee point corresponding to the discomfort threshold of the m-th frequency band, and outputs the determined knee point A5 (steps 258 to 262).

To this end, after step 256, the user determines whether the sound corresponding to the test signal output through the output terminal OUT6 is too loud (step 258). That is, the user determines whether the sound is too loud to hear properly, or whether the sound is too loud so that the ear is sore or if the user feels that no more loud sound is output. If the sound corresponding to the test signal is not too loud, the test signal is increased in magnitude by the fifth predetermined level and the process proceeds to step 258 (step 260). That is, when it is recognized that the user determines that the sound is not too loud through the third state signal input through the input terminal IN9, the third knee point determiner 284 increases the magnitude of the test signal by the fifth predetermined level. , Output a new test signal with increased level through output terminal OUT6. Accordingly, the user determines whether the sound corresponding to the new test signal is too loud and applies the determined result to the third knee point determiner 284 as a third status signal through the input terminal IN9. However, when the third knee point determination unit 284 recognizes that the user determines that the sound is too loud through the third state signal input through the input terminal IN9, the third knee point determination unit 284 determines the magnitude of the test signal corresponding to the loud sound as an unpleasant threshold. In operation 262, the knee point A5 corresponding to the determined discomfort threshold value is output.

After operation 262, the controller 286 determines whether the corresponding m-th frequency band is the M-th frequency band that is the last frequency band, and determines the first, second, and third knee point determination units 280, 282, and the determined result. 284) (Step 264). If the m th frequency band is the M th frequency band, the auditory characteristic test is terminated. To this end, the controller 286 controls the first, second and third knee point determination units 280, 282, and 284 so that the knee points are no longer determined. That is, the controller 286 prevents the test signal from being applied to the first, second and third knee point determination units 280, 282, and 284. However, if the m th frequency band is not the M th frequency band, m is increased by 1 and the flow proceeds to a step 244 (step 266). That is, steps 244 to 262 may be performed for the m + 1th frequency band. In this case, the controller 286 controls the first, second and third knee point determination units 280, 282, and 284 to generate a corresponding knee point. That is, the controller 286 controls the test signal for the m + 1 th frequency band to be input to each knee point determiner through the input terminal IN5.

Here, the test signal for the m-th frequency band input to the first, second and third knee point determination units 280, 282, and 284 may be applied from the outside through the input terminal IN5, or the controller 286. May be directly applied to each knee point determining unit.

Hereinafter, when the personal radio communication apparatus shown in FIG. 1 corresponds to a portable telephone apparatus, the configuration and operation of the portable telephone apparatus having the hearing correction function according to the present invention will be described as follows.

FIG. 16 is a block diagram of a portable telephone apparatus having an auditory correction function according to the present invention. The voice input unit 300 may be implemented as a microphone 302 or

the voice output unit may be implemented as a speaker 306. 304), Analog to Digital Converter (ADC) 310, DAC 14, Coder 316, Decoder 10, Central Processor 322, Modulation Demodulator 324, Hearing The correction unit 12, the display unit 328, the key input unit 326, and the input / output unit 330 are configured.

The decoder 10, the hearing corrector 12, and the DAC 14 shown in Figs. 16 and 1 are identical and perform the same function. In addition, the input / output unit 330 serves as the external interface unit described above.

The voice input unit 300 illustrated in FIG. 16 converts the voice input from the user into an analog voice signal and outputs the analog signal to the ADC 310. The voice input unit 300 may be implemented as a microphone 302. At this time, the ADC 310 converts the analog signal output from the voice input unit 300 into a digital form, and outputs the converted result to the coder 316. The encoder 316 encodes the output of the ADC 310 and outputs the encoded result to the central processing unit 322. Here, the central processing unit 322 adds additional information such as a header or an error correction code to the result coded by the coder 316, and outputs the additional information to the demodulator 324. The modulator 324 modulates a signal output from the central processing unit 322 and transmits the modulated result as a radio frequency (RF) signal through an antenna (not shown) through the output terminal OUT7.

The demodulator 324 demodulates the analog voice signal received through an antenna (not shown) and input through the input terminal IN10, and outputs the demodulated result to the central processing unit 322. The central processing unit 322 only takes necessary information from the demodulated result and then outputs it to the decoding unit 10. As described above, the decoding unit 10 decodes the audio signal and outputs the decoded result to the hearing correction unit 12. The hearing correction unit 12 deforms the magnitude of the decoded result in response to the hearing correction request signal output from the central processing unit 322 and outputs the decoded result to the DAC 14. Here, the key input unit 326 outputs the first key input signal to the central processing unit 322 when the user requests hearing correction, and the central processing unit 322 is connected to the first key input signal generated from the key input unit 326. In response, the hearing correction request signal is output to the hearing correcting unit 12. Therefore, when hearing correction is required from the outside, the hearing correction unit 12 outputs the decoded result to the DAC 14 after compressing the decoded result as described above, but does not compress the decoded result unless the hearing correction is required from the outside. It outputs to DAC 14 as it is without. At this time, the hearing correction unit 12 may input the hearing characteristics of the user input through the input / output unit 330 corresponding to the external interface unit (not shown) through the central processing unit 322 as described above. have.

The DAC 14 converts the digital signal output from the hearing correction unit 12 into an analog signal and outputs it to the audio output unit 304. In this case, the voice output unit 304 provides an analog voice signal output from the DAC 14 to the user as a sound, and for this purpose, may be implemented as a speaker 306. Here, the key input unit 326 generates a second key input signal and outputs the second key input signal to the central processing unit 322 when the user requests the inspection of the auditory characteristic. At this time, the central processing unit 322 outputs an auditory examination request signal to the auditory characteristics inspecting unit (not shown) in response to the second key input signal. Accordingly, an auditory characteristic inspector (not shown) that is separately provided or may be built in the auditory corrector 12 or the central processing unit 322 inspects the auditory characteristic illustrated in FIG. 14 in response to the auditory audit request signal. Do the method. In addition, the central processing unit 322 illustrated in FIG. 16 may provide the user with the current state of the apparatus illustrated in FIG. 16 through the display unit 328 or the input / output unit 330. The ADC 310 and the DAC 14 illustrated in FIG. 16 correspond to a coder (CODEC: CODE-DECoder) of a general mobile phone, and the coder 316 and the decoder 10 correspond to a VOCODER of a general mobile phone. Corresponding.

ADVANTAGEOUS-EFFECTS

As described above, the personal wireless communication device and method having the hearing correction function according to the present invention is that the sound is finally recognized by the hearing

characteristics of the individual, so that the input signal does not have a hearing impaired user or hearing impairment However, it has the effect of providing a comfortable and discriminating sound to the user by correcting to suit the hearing characteristics of each user having different auditory characteristics.

Claims

A decoder which decodes the demodulated digital voice signal received from the outside and outputs the decoded result;
An auditory corrector configured to modify a size of the decoded result input from the decoder according to a user's auditory characteristic, and output a digital speech signal having the modified size; And
And a digital / analog converter configured to convert the digital voice signal output from the hearing corrector into an analog voice signal and provide the digital voice signal to the user.
The method of claim 1, wherein the hearing correction unit
First to M-th band pass filters for filtering the decoded result for each desired frequency band and outputting the filtered results as first to M-th band signals;
Measuring magnitudes of each of the first to Mth band signals, modifying each of the measured magnitudes corresponding to the auditory characteristics, and outputting band signals having the modified magnitudes as first to Mth transform band signals First to Mth signal conversion units; And
A signal synthesizer configured to synthesize the first to Mth transform band signals and output the synthesized result;
The synthesized result is converted into an analog signal by the digital / analog converter and provided to the user.
The method of claim 2, wherein the m (1≤m≤M) signal conversion unit
A signal magnitude adjusting unit which measures the magnitude of the m-th band signal, detects a degree of change in the measured magnitude, and gradually increases or decreases the magnitude of the m-th band signal in response to the detected result;
A gain controller configured to output an m-th gain control signal by using the magnitude and the auditory characteristic of the m-th band signal having a magnitude larger or smaller in the signal magnitude adjusting unit; And
And an amplifying unit configured to vary the magnitude of the m-th band signal in response to the m-th gain control signal, and output an m-th band signal having a variable size as the m-th conversion band signal.
Personal wireless communication device having a.
The method of claim 3, wherein the signal amplitude adjusting unit
A magnitude measuring unit measuring and outputting a magnitude of the m-th band signal; And
The magnitude [A (n-1)] measured at a sample time n-1 at a sample time n by the magnitude measurement unit with respect to the m-th band signal. And a magnitude determining unit for gradually increasing or decreasing the magnitude of the m-th band signal in response to the compared result corresponding to the sensed result and outputting the result to the gain control unit. Personal wireless communication device having a.
5. The auditory correction function of claim 4, wherein the magnitude measuring unit measures an absolute value of the m th band signal, and outputs the absolute value to the magnitude determining unit as the measured magnitude of the m th band signal. Having a personal wireless communication device.
The method of claim 5, wherein the size determination unit
A first buffer configured to input and buffer the output of the size measuring unit;
A comparison unit comparing the output A (n) of the size measuring unit with the result buffered in the first buffer A (n-1) and outputting the compared results as the sensed results;
A first selector for selectively outputting one of a predetermined attack time or a predetermined release time in response to a result compared by the comparison unit;
A first multiplier;
A subtraction unit for subtracting an output of the first selection unit from a predetermined value and outputting a subtracted result;
A second multiplier configured to multiply the output of the subtractor by the output A (n) of the magnitude

measuring unit, and output a multiplied result;
An adder which adds the results multiplied by the first and second multipliers and outputs the added result as a variable magnitude [Mag (n)] at a certain sample time n; And
A second buffer configured to buffer the output of the adder and output the buffered result to the first multiplier,
And the first multiplier multiplies the result buffered in the second buffer and the output of the first selector.
The method of claim 6, wherein the size determiner
And a second selector for selectively outputting either the output of the adder or the result [A (n-1)] buffered in the first buffer to the gain controller in response to the result compared by the comparator. A personal wireless communication device having an auditory correction function.
8. The method according to claim 6 or 7, wherein the predetermined attack time is a time required to reach a level higher by a first predetermined level than a level when the output of the size determining unit with respect to the output of the size measuring unit is stabilized. T .sub.r corresponds to T .sub.r , and the predetermined release time corresponds to T .sub.f , which is a time required to reach a level lower by a second predetermined level than the level when the output of the size determining unit to the output of the size measuring unit is stabilized. Personal wireless communication device having a hearing correction function, characterized in that.
The device of claim 1, wherein the personal wireless communication device is
And an external interface unit for inputting the user's hearing characteristics from the outside and outputting the hearing characteristics of the user to the hearing correction unit.
The device of claim 2, wherein the personal wireless communication device is
Personal hearing device having an auditory correction function, characterized in that it further comprises an auditory characteristic tester for inspecting the auditory characteristic of the user itself.
The device of claim 1, wherein the personal wireless communication device is
A storage unit for previously inputting and storing an auditory characteristic table having information on a plurality of auditory characteristics; And
And a third selector for selectively outputting one auditory characteristic in response to a selection signal in the auditory characteristic table stored in the storage.
And the user determines the selection signal by listening to sounds corresponding to the plurality of auditory characteristics.
The m-th signal converter of claim 2 or 10.
Linearly connecting knee points representing the auditory characteristics and finding the magnitude of the m th conversion band signal corresponding to the magnitude of the m th band signal on the connected line;
The knee point is a personal wireless communication device having an auditory correction function, characterized in that the X-axis is the magnitude of the m-th band signal, the Y-axis corresponds to a point on the X and Y coordinates of the magnitude of the m-th conversion band signal .
The method of claim 12, wherein the auditory characteristic test unit
The audible threshold value of the m-th frequency band input in response to a control signal among the first to M-th frequency bands corresponding to the first to Mth band signals is determined, and the knee point corresponding to the determined home threshold value is determined. A first knee point determiner for outputting a;
A second knee point determination unit which determines the knee point (s) providing a comfortable feeling to the user of the mth frequency band and outputs the determined knee point (s);
A third knee point determination unit which determines a discomfort threshold of the mth frequency band and outputs a knee point corresponding to the determined discomfort threshold; And
The control signal is generated in response to the user requesting an examination of the auditory characteristics, and the first, second, and the second correspond to whether the knee points for the first to Mth frequency bands are all obtained. And a control unit for controlling the knee point determination of third knee point determination units, wherein the auditory characteristic is comprised of the knee points.
The method of claim 13, wherein the second knee point determiner
And a knee point corresponding to a slightly smaller sound and a knee point corresponding to a slightly louder sound than the sound corresponding to the knee point to be output.
12. The device of claim 1, 9, 10 or 11, wherein the personal wireless communication device

A voice input unit converting the voice input from the user into an analog voice signal and outputting the voice signal;
An analog / digital converter for converting the voice signal in analog form into a digital form and outputting the converted result;
A coder for encoding and outputting an output of the analog / digital converter;
A modulator for modulating the encoded result;
A demodulator for demodulating a voice signal received from the outside and outputting a demodulated result;
A voice output unit for providing the analog voice signal output from the digital / analog converter to the user as sound;
A central processor configured to input the encoded result to the modulator, input the demodulated result to output the demodulated digital voice signal to the decoder, and output an auditory correction request signal in response to a first key input signal ; And
And a key input unit configured to output the first key input signal when the user requests hearing correction.
And the hearing correcting unit deforms the magnitude of the decoded result in response to the hearing correction request signal.
16. The device of claim 15, wherein in the personal wireless communication device
The key input unit generates a second key input signal when the user requests the test of the auditory characteristic, the central processing unit outputs an auditory test request signal in response to the second key input signal, and the auditory characteristic checker And the auditory characteristic of inspecting the hearing characteristic in response to the hearing test request signal.
(a) decoding the demodulated digital speech signal received from the outside;
(b) modifying the magnitude of the decoded result signal corresponding to a user's hearing characteristics to obtain a digital speech signal having the modified magnitude; And
(c) converting the digital voice signal having the modified magnitude into an analog voice signal and providing the same to the user.
18. The method of claim 17, wherein step (b)
(b1) dividing the result decoded in step (a) for each desired frequency band to obtain first to Mth band signals;
(b2) modifying the magnitudes of the first to Mth band signals corresponding to the auditory characteristics and obtaining the first to Mth transform band signals which are band signals having the modified magnitudes; And
(b3) synthesizing the first to Mth transform band signals, and proceeding to step (c),
And the synthesized result is converted into an analog signal and provided to a user.
19. The method of claim 18, wherein step (b2) comprises: for each m (1 m M) band signal,
(b21) after the step (b1), measuring the magnitude of the m-th band signal;
(b22) gradually increasing or decreasing the magnitude of the m-th band signal corresponding to the measured change in magnitude; And
(b23) varying the size of the m-th band signal by using the magnitude of the m-th band signal having a size that is finally larger or smaller in step (b22) and the auditory characteristic, and the m-th having a variable size And determining a band signal as the m-th conversion band signal and proceeding to step (b3).
The method of claim 19, wherein step (b22)
The magnitude [A (n)] measured at any sample time n for the m-th band signal is greater than the magnitude [A (n-1)] measured at one sample previous time n-1. Determining whether the error is greater;
If A (n) is greater than or equal to the first threshold than A (n-1), the measured size [A (n)] is gradually reduced as follows, and finally the size [Mag (n) Obtaining an m-th band signal having a)] and proceeding to step (b23);

(T .sub.r means the time taken to reach a level higher by a first predetermined level than the level when the magnitude of the m-th band signal with respect to the measured magnitude of the m-th band signal is finally reduced. do.)
Determining that A (n) is less than or equal to A (n-1) by a second threshold value if A (n) is not greater than A (n-1) or more than the first threshold value; And

If A (n) is less than the second threshold than A (n-1), the measured magnitude [A (n)] is gradually increased as follows, and finally the magnitude [Mag (n) Obtaining an m-th band signal having a) and proceeding to step (b23).

Here, T .sub.f means the time required to reach a level lower by a second predetermined level than the level when the magnitude of the m-th band signal with respect to the measured magnitude of the m-th band signal is finally increased. .)
The method of claim 20, wherein step (b22)
If the A (n) is not less than the second threshold value than the A (n-1), a magnitude [Mag (n-1)] which is finally larger or smaller at a sample previous time n-1 is determined. Determining as a finally larger or smaller magnitude [Mag (n)] at sample time (n), and further proceeding to step (b23).
The method of claim 20, wherein step (b22)
If the A (n) is not less than the second threshold value than the A (n-1), the measured size [A (n)] is varied as follows to have a variable size [Mag (n)]. And obtaining a band signal and proceeding to step (b23).

The method of claim 20, wherein step (b22)
If the A (n) is not less than the second threshold value than the A (n-1), the measured size [A (n)] is varied as follows to have a variable size [Mag (n)]. And obtaining a band signal and proceeding to step (b23).

19. The method of claim 18, wherein the user's hearing characteristics are given from outside.
19. The method of claim 18, wherein the personal wireless communication method is
And (d) proceeding to step (b) by self-inspecting the hearing characteristics of the user.
The method of claim 18, wherein the hearing characteristics of the user
A personal wireless communication method having an auditory correction function, characterized in that it corresponds to an auditory characteristic determined by a user by listening to sounds corresponding to the plurality of auditory characteristics among a plurality of auditory characteristics previously given from the outside.
The method of claim 25, wherein step (d)
(d1) continuously determining whether the measurement of the auditory characteristic is required;
(d2) if a measurement of the auditory characteristic is required, selecting a first frequency band from the first to Mth frequency bands;
(d3) determining a knee point for the audible threshold of the corresponding m-th frequency band;
(d4) determining knee points which provide a comfortable feeling to the user of the m-th frequency band;
(d5) determining a knee point corresponding to the discomfort threshold of the m-th frequency band;
(d6) determining whether the corresponding m th frequency band is the last M th frequency band, and if the m th frequency band is the M th frequency band, proceeding to step (b); And
(d7) if the mth frequency band is not the Mth frequency band, increasing m by 1 and proceeding to step (d3), And wherein said auditory characteristic consists of said knee points.
The method of claim 27, wherein step (d3)
(d31) generating a test signal having a predetermined minimum magnitude;
(d32) determining whether the user can hear a sound corresponding to the test signal;
(d33) if the user cannot hear the sound, increasing the magnitude of the test signal by a third predetermined level and proceeding to step (d32); And
(d34) if the user can hear the sound, determine the magnitude of the test signal corresponding to the audible sound as the audible threshold, determine the knee point for the home threshold using the audible threshold, and (and d4) the step of personal hearing communication.
The method of claim 28, wherein step (d4)
(d41) after the step (d3), the user determines whether the sound corresponding to the test signal provides a comfortable feeling;
(d42) if the sound does not provide a comfortable feeling, increasing the magnitude of the test signal by a fourth predetermined level and proceeding to step (d41); And
(d43) if the sound provides a comfortable feeling, determining the knee point using the magnitude of the test signal corresponding to the sound providing the comfortable feeling, and proceeding to step (d5). A personal

wireless communication method having an auditory correction function.
The method of claim 29, wherein step (d5)
(d51) after the step (d4), the user determines whether the sound corresponding to the test signal is too loud;
(d52) if the sound is not too loud, increasing the magnitude of the test signal by a fifth predetermined level and proceeding to step (d51); And
(d53) if the sound is too loud, determining the magnitude of the test signal corresponding to the loud sound as the discomfort threshold, determining the knee point using the discomfort threshold, and proceeding to step (d6). Personal wireless communication method having an auditory correction function, characterized in that it comprises.
31. The method of claim 28, 29 or 30, wherein the test signal is
And a pure tone signal corresponding to the center frequency of the m-th frequency band or a complex signal in which frequency components within the m-th frequency band are added together.

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(54) 청각 보정 기능을 갖는 개인용 무선 통신 장치 및 방법

요약

사용자에게 제공될 소리의 크기 및 특성을 사용자 개개인의 청각 특성에 맞추어 보정하는 청각 보정 기능을 갖는 개인용 무선 통신 장치 및 방법이 개시된다. 이 장치는, 외부로부터 수신되어 복조된 디지탈 음성 신호를 복호화하고, 복호화된 결과를 출력하는 복호부와, 복호부로부터 입력한 복호화된 결과의 크기를 사용자의 청각 특성에 상응하여 변형시키고, 변형된 크기를 갖는 디지탈 음성 신호를 출력하는 청각 보정부 및 청각 보정부로부터 출력되는 디지탈 음성 신호를 아날로그 음성 신호로 변환하여 사용자에게 제공하는 디지탈/아날로그 변환부를 구비하는 것을 특징으로 한다. 그러므로, 사용자에게 편안하고 변별력 있는 소리를 제공할 수 있는 효과를 갖는다.

대표도
도 1

명세서

도면의 간단한 설명

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도 1은 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 장치의 블럭도이다.

도 2는 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 방법을 설명하기 위한 플로우차트이다.

도 3은 인간의 일반적인 주파수별 청각 특성을 나타내는 그래프이다.

도 4a ~ 4c들은 다양한 청각 특성들을 나타내는 그래프들이다.

도 5는 도 1에 도시된 청각 보정부의 본 발명에 의한 바람직한 일 실시예의 블럭도이다.

도 6은 도 5에 도시된 제m 신호 변환부의 본 발명에 의한 바람직한 일 실시예의 블럭도이다.

도 7은 도 5에 도시된 제m 신호 변환부에서 제m 변환 밴드 신호를 발생하는 본 발명에 의한 바람직한 일 실시예에 의한 동작을 설명하기 위한 플로우차트이다.

도 8a 및 도 8b들은 크기 측정부의 입력 및 출력을 나타내는 그래프들이다.

도 9는 도 6에 도시된 크기 결정부의 본 발명에 의한 바람직한 일 실시예의 블럭도이다.

도 10a 및 10b는 필터 뱅크로 입력되는 신호 및 신호 합성부로부터 출력되는 신호의 파형도들을 나타낸다.

도 11 (a) 및 (b)들은 제1 소정 어텍 시간 및 제2 소정 릴리스 시간들을 설명하기 위한 파형도들이다.

도 12는 본 발명에 의한 밴드 신호 압축 과정을 설명하기 위한 그래프이다.

도 13은 본 발명에 의한 밴드 신호 압축 과정을 설명하기 위한 그래프이다.

도 14는 본 발명에 의한 청각 특성 검사 방법을 설명하기 위한 플로우차트이다.

도 15는 본 발명에 의한 청각 특성 검사부의 본 발명에 의한 바람직한 일 실시예의 블럭도이다.

도 16은 본 발명에 의한 청각 보정 기능을 갖는 휴대용 전화 장치의 블럭도이다.

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 휴대 전화 장치등과 같은 개인용 무선 통신 장치에 관한 것으로서, 특히 청각 보정 기능을 갖는 개인용 무선 통신 장치 및 방법에 관한 것이다.

종래의 휴대 전화 장치의 주된 목적은 적은 량의 데이타로 원음에 가까운 높은 음질의 소리를 송/수신하는 것이다. 따라서, 보코더- vocoder(voice coder), EVRC(enhanced variable rate codec.), AMR(Adaptive Multirate Codec.) 등- 에 관련된 기술은 발달되어 왔다.

한편, 현대인은 환경적인 요인으로 인하여 청각 장애를 다소간 갖고 있으며, 노령화에 따른 고주파 난청 등의 장애는 피하기 어렵다. 게다가, 선천적 또는 후천적 질병에 의해 난청을 갖게 되는 사람들도 있다. 이와 같이 소리를 듣는 휴대 전화 장치의 사용자가 정상적인 청각 특성의 소유자이든지 비 정상적인 청각 특성의 소유자이든지 상관없이 그 사용자는

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각자의 고유한 청각 특성을 가지고 있다. 여기서, 비 정상적인 청각 특성이란, 소리를 인지할 수 있는 소리의 세기 범위(dynamic range)가 줄어든 청각 장애 따위를 지칭하며, 이에 대해서는 상세하게 후술된다.

그러나, 종래의 휴대 전화 장치는 사용자의 청각 특성에 따른 소리의 보정 기능을 갖기 못하였기 때문에 사용자의 청각 특성에 부합하는 소리를 제공할 수 없는 문제점을 갖는다. 특히, 노인이나 청각 이상 등에 의해 청각에 장애가 있는 사용자를 위해 소리의 보정이 필수적임에도 불구하고, 이러한 종래의 휴대 전화 장치는 소리의 보정 기능을 제공할 수 없었다.

발명이 이루고자 하는 기술적 과제

본 발명이 이루고자 하는 기술적 과제는, 사용자에게 제공될 소리의 크기 및 특성을 사용자 개개인의 청각 특성에 맞추어 보정하는 청각 보정 기능을 갖는 개인용 무선 통신 장치를 제공하는 데 있다.

본 발명이 이루고자 하는 다른 기술적 과제는, 상기 개인용 무선 통신 장치에서 수행되는 청각 보정 기능을 갖는 개인용 무선 통신 방법을 제공하는 데 있다.

발명의 구성 및 작용

상기 과제를 이루기 위한 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 장치는, 외부로부터 수신되어 복조된 디지탈 음성 신호를 복호화하고, 복호화된 결과를 출력하는 복호부와, 상기 복호부로부터 입력한 상기 복호화된 결과의 크기를 사용자의 청각 특성에 상응하여 변형시키고, 변형된 크기를 갖는 디지탈 음성 신호를 출력하는 청각 보정부 및 상기 청각 보정부로부터 출력되는 상기 디지탈 음성 신호를 아날로그 음성 신호로 변환하여 상기 사용자에게 제공하는 디지탈/아날로그 변환부로 구성되는 것이 바람직하다.

상기 다른 과제를 이루기 위한 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 방법은, 외부로부터 수신되어 복조된 디지탈 음성 신호를 복호화하는 단계와, 상기 복호화된 결과의 신호의 크기를 사용자의 청각 특성에 상응하여 변형시켜, 변형된 크기를 갖는 디지탈 음성 신호를 구하는 단계 및 상기 변형된 크기를 갖는 상기 디지탈 음성 신호를 아날로그 음성 신호로 변환하여 상기 사용자에게 제공하는 단계로 이루어지는 것이 바람직하다.

이하, 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 장치의 구성 및 동작과, 그 장치에서 수행되는 무선 통신 방법을 첨부한 도면들을 참조하여 다음과 같이 설명한다.

도 1은 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 장치의 블럭도로서, 복호부(10), 청각 보정부(12) 및 디지탈/아날로그 변환부(DAC:Digital to Analog Converter)(14)로 구성된다.

도 2는 도 1에 도시된 장치에서 수행되는 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 방법을 설명하기 위한 플로우차트로서, 음성 신호를 복호화하는 단계(제20 단계), 복호화된 결과의 크기를 사용자의 청각 특성에 상응하여 변형시키는 단계(제22 ~ 제26 단계) 및 변형된 신호를 아날로그 신호로 변환하는 단계(제28 단계)로 이루어진다.

먼저, 도 1에 도시된 복호부(10)는 외부로부터 수신되어 복조된 디지탈 음성 신호를 입력단자 IN1을 통해 입력하여 복호화하고, 복호화된 결과를 청각 보정부(12)로 출력한다(제20 단계).

제20 단계후에, 청각 보정부(12)는 복호부(10)로부터 입력한 복호화된 결과의 크기를 입력단자 IN2를 통해 입력한 사용자의 청각 특성에 상응하여 변형시키고, 변형된 크기를 갖는 디지탈 음성 신호를 디지탈/아날로그 변환부(14)로 출력한다(제22 ~ 제26 단계들).

제22 ~ 제26 단계들을 설명하기에 앞서, 인간의 일반적인 청각 특성에 대해 다음과 같이 살펴본다.

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도 3은 인간의 일반적인 주파수별 청각 특성을 나타내는 그래프로서, 종축은 음압(sound pressure)을 나타내고, 횡축은 주파수를 각각 나타낸다. 여기서, 참조부호 44는 음성(speech)에 대한 음압 분포를 나타내고, 참조부호 46은 음악에 대한 음압 분포를 각각 나타낸다.

인간이 들을 수 있는 가장 작은 소리의 크기(HT:hearing threshold, 이하, 가청 역치라 한다.)와 귀에 통증을 느끼거나 청각 작용에 이상을 일으킬 수 있는 최대 소리의 크기(UCL:UnComfortable hearing Level, 이하, 불쾌 역치라 한다.)가 주파수 별로 다르게 분포한다. 여기서, HT와 UCL 사이의 범위를 '소리의 세기 범위'라 한다. 또한, 가청 역치 및 불쾌 역치는 사람마다 차이가 나며, 특히 난청이 심한 경우에 이러한 역치들은 다양한 형태로 나타난다. 도 3에 도시된 바와 같이, 이상이 있는 청각을 갖는 비 정상인의 HT(42)는 정상적인 청각을 갖는 정상인의 HT(40)보다 올라가고, 비 정상인의 UCL(48)는 정상인의 UCL(50)보다 내려가는 것이 일반적으로 나타나는 현상이다.

도 4a ~ 4c들은 다양한 청각 특성들을 나타내는 그래프들로서, 도 4a는 정상인의 평균적인 청각특성을 나타내고, 도 4b는 전도성 청각 장애(conductive loss)를 갖는 비 정상인의 평균적인 청각 특성을 나타내고, 도 4c는 감음 신경성 난청(sensorineural loss)을 갖는 비 정상인의 평균적인 청각 특성을 각각 나타낸다. 도 4b ~ 4c에서, 점선은 정상적인 사용자의 일반적인 HT를 나타내고, 실선은 정상적이거나 비 정상적인 사용자의 HT와 등 감각 레벨(사용자가 같은 크기의 소리로 감지하는 주파수별 음압을 등고선 형식으로 나타낸 것)을 각각 나타낸다.

도 4b에 도시된 전도성 청각 장애를 갖는 비 정상적인 사용자의 청각 특성은 도 4a에 도시된 정상적인 사용자와 비교하여 상승하였으며 각각의 주파수와 음압에 대해서 정상적인 경우와 같은 형태의 등고선을 유지한 것을 알 수 있다. 이는 전도성 난청의 경우 주파수에 따른 소리의 왜곡은 적고 전체 주파수 영역에서 소리를 듣기가 어려울 뿐이다. 반면, 도 4c에 도시된 감음 신경성 난청을 갖는 비 정상인적인 사용자의 HT와 각각의 주파수와 음압에 대한 감각 레벨은 정상인에 비해 고주파 영역에서 청각 능력이 상실된 예를 보인다. 이 경우 주파수에 따른 보상이 필요하며 본 발명은 이러한 경우의 청각 보상에 특히 유효하다.

따라서, 도 1에 도시된 청각 보정부(12)는 제22 ~ 제26 단계들을 수행하여, 복호화된 결과의 크기를 주파수 별로 사용자가 들을 수 있는 소리의 세기 범위(dynanmic range)로 개인용 무선 통신 장치를 사용하는 사용자의 청각 특성에 따라 변형하여 준다. 예컨데, 청각 보정부(12)는 4KHz 주파수 신호에 대해서 도 4c에 도시된 바와 같이 정상적인 사용자가 들을 수 있는 소리의 세기 범위(60)를 비 정상적인 사용자가 들을 수 있는 소리의 세기 범위(62)로 변형하여 주는 역할을 한다. 여기서, 입력 신호인 소리의 세기 범위를 60으로부터 62로 줄이는 변형을 '압축(compression)'이라고 한다.

도 1에 도시된 청각 보정부(12)에서 수행되는 제22 ~ 제26 단계들에 대하여 첨부된 도면들을 참조하여 다음과 같이 설명한다.

도 5는 도 1에 도시된 청각 보정부(12)의 본 발명에 의한 바람직한 일 실시예의 블럭도로서, 제1 ~ 제M 대역 통과 필터(BPF:Band Pass Filter)들(72, 74, ... 및 76)로 구성되는 필터 뱅크(70), 제1 ~ 제M 신호 변환부들(82, 84, ... 및 86)로 구성되는 부(80) 및 신호 합성부(90)로 구성된다.

먼저, 제20 단계후에, 필터 뱅크(70)의 대역 통과 필터들(72, 74, ... 및 76)은 입력단자 IN3를 통해 복호부(10)로부터 입력한 복호화된 결과를 원하는 주파수 대역별로 필터링하고, 필터링된 결과들을 제1 ~ 제M 밴드 신호들로서 제1 ~ 제M 신호 변환부들(82, 84, ... 및 86)로 출력한다(제22 단계). 예컨데, 제m($1 \le m \le M$) 대역 통과 필터(72, 74, ...

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또는 76)는 복호화된 결과를 원하는 m번째 주파수 대역에서 필터링하고, 필터링된 결과를 제m 밴드 신호로서 제m 신호 변환부(82, 84, ... 또는 86)로 출력한다. 여기서, 대역 통과 필터의 수(M)는 4 ~ 8개가 될 수 있고, 각 대역 통과 필터는 옥타브(octave band) 필터로 구현될 수 있다. 이 때, M과 각 대역 통과 필터의 폭은 고정될 수 있다. 이와 같이, 복호화된 결과를 원하는 주파수 대역별로 필터링하는 이유는, 사용자의 청각 이상 또는 청각 차이는 주파수 별로 다르게 나타나는 것이 일반적인 유형이므로, 복호화된 결과의 이득을 주파수 대역별로 다르게 조정하기 위함이다.

제22 단계후에, 제1 ~ 제M 신호 변환부들(82, 84, ... 및 86)로 구성되는 부(80)는 제1 ~ 제M 밴드 신호들 각각의 크기를 측정하고, 측정된 크기들 각각을 입력단자 IN2을 통해 입력한 사용자의 청각 특성에 상응하여 변형시키고, 변형된 크기들을 갖는 밴드 신호들을 제1 ~ 제M 변환 밴드 신호들로서 신호 합성부(90)로 출력한다(제24 단계). 예컨데, 제m 신호 변환부(82, 84, ... 또는 86)는 제m 밴드 신호의 크기를 측정하고, 측정된 크기를 입력단자 IN2을 통해 입력한 청각 특성에 상응하여 변형시키고, 변형된 크기를 갖는 제m 변환 밴드 신호를 신호 합성부(90)로 출력한다.

도 5에 도시된 각 신호 변환부(82, 84, ... 또는 86)의 본 발명에 의한 바람직한 일 실시예의 구성 및 동작을 살펴보면 다음과 같다.

도 6은 도 5에 도시된 제m 신호 변환부의 본 발명에 의한 바람직한 일 실시예의 블럭도로서, 크기 측정부(106) 및 크기 결정부(108)로 구성되는 신호 크기 조정부(100), 이득 제어부(102) 및 증폭부(104)로 구성된다.

도 7은 도 5에 도시된 제m 신호 변환부에서 제m 변환 밴드 신호를 발생하는 본 발명에 의한 바람직한 일 실시예에 의한 동작을 설명하기 위한 플로우차트로서, 제m 밴드 신호의 크기를 측정하는 단계(제120 단계), 측정된 크기를 조정하는 단계(제122 ~ 제130 단계들) 및 제m 밴드 신호의 이득을 조정된 크기와 청각 특성에 상응하여 변화시키는 단계(제132 및 제134 단계들)로 이루어진다.

먼저, 도 6에 도시된 제m 신호 변환부(82, 84, ... 또는 86)의 신호 크기 조정부(100)는 제22 단계후에, 입력단자 IN4를 통해 제m BPF(72, 74, ... 또는 76)로부터 입력한 제m 밴드 신호의 크기를 측정하고, 측정된 크기의 변화 정도가 큰가를 감지하며, 감지된 결과에 응답하여 제m 밴드 신호의 크기를 점차적으로 크게 하거나 점차적으로 작게하여 이득 제어부(102)로 출력한다(제120 ~ 제130 단계).

여기서, 신호 크기 조정부(100)의 역할을 살펴보면 다음과 같다.

도 6에 도시된 신호 크기 조정부(100)가 마련되지 않는다고 하더라도, 청각 보정부(12)에 의해, 사용자에게 제공되는 소리의 크기가 작을 경우 소리는 적당히 크게 되고, 소리의 크기가 너무 클 경우 소리의 적당히 줄어든다. 그런데, 신호의 크기가 갑자기 커지거나 갑자기 작아지면, 아주 큰 소리 또는 아주 작은 소리가 출력될 수 있다. 즉, 입력 신호에 해당하는 작은 소리가 갑자기 크게 변할 때, 입력 신호의 크기 보다 줄어든 크기를 갖는 신호가 출력되어야 한다. 그러나, 이 경우, 갑자기 소리의 크기를 줄이면 언어의 벌벌력을 떨어뜨릴 수도 있고, 또한 순간적으로 큰 소리가 의미 있는 소리 예를 들어, 필요한 자동차의 경적 소리 등일 경우, 이러한 의미있는 소리를 제대로 사용자에게 전달하지 못하는 문제들이 발생한다. 이러한 문제들을 해결하기 위해, 전술한 신호 크기 조정부(100)가 마련된다.

이를 위해, 도 6에 도시된 신호 크기 조정부(100)의 크기 측정부(106)는 제22 단계후에 입력단자 IN4를 통해 제m BPF로부터 입력한 제m 밴드 신호의 크기를 측정하고, 측정된 크기를 크기 결정부(108)로 출력한다(제120 단계).

도 8a 및 도 8b들은 크기 측정부(106)의 입력 및 출력을 나타내는 그래프들로서, 도 8a는 크기 측정부(106)에 입력되는 20K 샘플링된 제m 밴드 신호의 예시적인 파형도를 나타내고, 도 8b는 이 신호에 대해서 크기 측정부(106)로부터 출력되는 제m 밴드 신호의 크기 즉, 엔벨로프(envelope)를 각각 나타내며, 횡축은 시간(n)을 나타내고, 종축은 제m 밴드 신호의 크기를 각각 나타낸다.

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본 발명의 바람직한 일 실시예에 의하면, 크기 측정부(106)는 도 8a에 도시된 제m 밴드 신호의 엔벨로프를 크기로서 측정하고, 도 8b에 도시된 측정된 크기를 크기 결정부(108)로 출력할 수 있다. 그러나, 엔벨로프를 정확히 계산하기 위해서는 많은 연산량이 필요하고 시간 지연된 결과를 얻을 수 밖에 없다. 그러므로, 본 발명에 의한 다른 실시예에 의하면, 크기 측정부(106)는 제m 밴드 신호의 엔벨로프 대신에 절대값을 측정하고, 측정한 절대값을 제m 밴드 신호의 측정된 크기로서 크기 결정부(108)로 출력할 수도 있다. 따라서, 크기 측정부(106)는 적은 연산량에도 불구하고 효과적으로 제m 밴드 신호의 크기를 측정할 수 있다.

제120 단계후에, 크기 결정부(108)는 제m 밴드 신호에 대해 크기 측정부(106)에서 어느 샘플 시간(n)에서 측정된 크기[A(n)]를 한 샘플 이전 시간(n-1)에 측정된 크기[A(n-1)]와 비교하고, 비교된 결과에 응답하여 제m 밴드 신호의 크기를 점차적으로 크게 하거나 작게 하여 이득 제어부(102)로 출력한다(제122 ~ 제130 단계들).

도 9는 도 6에 도시된 크기 결정부(108)의 본 발명에 의한 바람직한 일 실시예의 블럭도로서, 제1 및 제2 버퍼들(150 및 156), 비교부(152), 제1 및 제2 선택부들(154 및 166), 제1 및 제2 승산부들(158 및 162), 감산부(160) 및 가산부(164)로 구성된다.

도 10a 및 10b들은 도 5에 도시된 필터 뱅크(70)로 입력되는 신호의 파형도를 나타내고, 도 10b는 도 5에 도시된 신호 합성부(90)로부터 출력되는 신호의 파형도를 각각 나타낸다.

도 9에 도시된 제1 버퍼(150)는 크기 측정부(106)에서 측정된 크기(A)를 입력하여 버퍼링하고, 버퍼링된 결과를 비교부(152)로 출력한다. 그러므로, 제1 버퍼(150)로 A(n)가 입력될 때 제1 버퍼(150)로부터 출력되는 버퍼링된 결과는 A(n-1)가 된다. 이 때, 비교부(152)는 제m 밴드 신호에 대해 어느 샘플 시간(n)에서 크기 측정부(106)에서 측정된 크기[A(n)]가 한 샘플 이전 시간(n-1)에서 측정된 제1 버퍼(150)에 버퍼링된 결과인 크기[A(n-1)]보다 제1 임계값(Th1) 이상 큰가를 판단하고, 판단된 결과를 측정된 크기의 변화 정도를 감지한 결과로서 출력한다(제122 단계). 즉, 제122 단계에서, 비교부(152)는 크기 측정부(106)에서 측정된 크기가 급격하게 커졌는가를 판단한다. 예컨데, 측정된 크기[A]가 A(a)로부터 A(b)로 급격하게 커졌는가를 판단한다.

도 11(a) 및 11(b)들은 제1 소정 어텍(attack) 시간 및 제2 소정 릴리스(release) 시간들을 설명하기 위한 파형도들로서, 도 11(a)는 도 5에 도시된 필터 뱅크(70)로 입력되는 신호를 구형파의 형태로 나타낸 타이밍도이고, 도 11(b)는 도 5에 도시된 신호 합성부(90)로부터 출력되는 신호를 구형파의 형태로 나타낸 타이밍도이다.

만일, 도 10a에 도시된 바와 같이 측정된 크기 A(n)(182)이 A(n-1)(180)보다 제1 임계값(Th1) 이상 크면, 도 10b에 도시된 바와 같이 신호의 크기[A(n)]를 점차적으로 작게 하고, 다음 수학식 1과 같이 표현되는 최종적으로 결정된 크기[Mag(n)]를 갖는 제m 밴드 신호를 구하고 제132 단계로 진행한다(제124 단계).

수학식 1

$$Mag(n)=T_r*Mag(n-1)+(1-T_r)*A(n)$$

여기서, 소정 어택 시간(T_r)은 크기 측정부(106)에서 측정된 크기에 대해서 도 11(b)에 도시된 바와 같이 제m 밴드 신호의 크기가 최종적으로 작아질 때의 레벨(190)보다 제1 소정 레벨 만큼 높은 레벨(192)에 도달할 때 까지 소요되는 시간을 의미한다. 여기서, 레벨(190)은 크기 결정부(108)의 출력이 안정화될 때의 레벨에 해당한다. 제1 소정 레벨은 도 11(b)에 도시된 바와 같이 2dB가 될 수 있다.

그러나, 비교부(152)는 A(n)가 A(n-1)보다 제1 임계값(Th1) 이상 크지 않으면, A(n)이 A(n-1)보다 제2 임계값

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(Th2) 이상 적은가를 판단한다(제126 단계). 즉, 비교부(152)는 크기 측정부(106)에서 측정된 크기가 급격하게 작아졌는가를 판단한다. 예컨데, 도 10a에 도시된 바와 같이 측정된 크기[A]가 A(b)로부터 A(a)로 변하였는가를 판단한다. 만일, 도 10a에 도시된 바와 같이 A(n)(186)이 A(n-1)(184)보다 제2 임계값(Th2) 이상 적으면, 도 10b에 도시된 바와 같이 측정된 크기[A(n)]를 점차적으로 크게하여, 다음 수학식 2에 표현된 최종적으로 커진 크기[Mag(n)]를 갖는 제m 밴드 신호를 구하고 제132 단계로 진행한다(제128 단계).

수학식 2

$$Mag(n)=T_f*Mag(n-1)+(1-T_f)*A(n)$$

여기서, 소정 릴리스 시간(T_f)은 크기 측정부(106)에서 측정된 크기에 대해서 도 11(b)에 도시된 바와 같이 제m 밴드 신호의 크기가 최종적으로 커졌을 때의 레벨(194)보다 제2 소정 레벨만큼 낮은 레벨(196)에 도달할 때 까지 소요되는 시간을 의미한다. 여기서, 레벨(194)은 크기 결정부(108)의 출력이 안정화될 때의 레벨에 해당한다. 제2 소정 레벨은 도 11(b)에 도시된 바와 같이 2dB가 될 수 있다.

제124 단계 및 제128 단계들을 수행하기 위해, 크기 결정부(108)는 제1 선택부(154), 제1 및 제2 승산부들(158 및 162), 감산부(160), 가산부(164) 및 제2 버퍼(156)을 마련할 수 있다.

여기서, 제1 선택부(154)는 소정 어텍 시간(T_r) 또는 소정 릴리스 시간(T_f)중 하나를 비교부(152)에서 비교된 결과에 응답하여 선택적으로 출력한다. 즉, 제1 선택부(154)는 비교부(152)에서 비교된 결과를 통해, A(n)이 A(n-1)보다 제1 임계값(Th1) 이상 큰 것으로 판단되면 소정 어텍 시간(T_r)을 선택하여 출력하고, A(n)이 A(n-1)보다 제2 임계값(Th2) 이상 적은 것으로 판단되면 소정 릴리스 시간(T_f)을 선택하여 출력한다. 이 때, 제1 승산부(158)는 제2 버퍼(156)에서 버퍼링된 결과[Mag(n-1)]와 제1 선택부(154)의 출력을 승산하고, 승산된 결과를 가산부(164)로 출력한다. 감산부(160)는 소정값 예를 들면 '1'로부터 제1 선택부(154)의 출력을 감산하고, 감산된 결과를 제2 승산부(162)로 출력한다. 승산부(162)는 감산부(160)의 출력과 크기 측정부(106)의 출력[A(n)]을 승산하고, 승산된 결과를 가산부(164)로 출력한다. 가산부(164)는 제1 및 제2 승산부들(158 및 162)에서 승산된 결과들을 가산하고, 가산된 결과를 샘플 시간(n)에서 가변된 전술한 수학식 1 또는 2에 표현된 크기[Mag(n)]로서 출력한다. 이 때, 제2 버퍼(156)는 가산부(164)의 출력을 버퍼링하고, 버퍼링된 결과[Mag(n-1)]를 제1 승산부(158)로 출력한다.

한편, 본 발명에 의한 바람직한 일 실시예에 의하면, A(n)이 A(n-1)보다 제2 임계값(Th2) 이상 적지 않은 것으로 판단되면, 즉, A(n)의 레벨이 A(n-1)의 레벨보다 급격하게 커졌거나 급격하게 작아지지 않은 것으로 판단되면, 한 샘플 이전 시간(n-1)에서 최종적으로 커졌거나 작아진 크기[Mag(n-1)]를 어느 샘플 시간(n)에서 최종적으로 커졌거나 또는 작아진 크기[Mag(n)]로서 결정하고, 제132 단계로 진행한다(제130 단계). 이를 위해, 크기 결정부(108)는 가산부(164)의 출력 또는 제1 버퍼(150)에서 버퍼링된 결과[A(n-1)]중 하나를 비교부(152)에서 비교된 결과에 응답하여 선택적으로 이득 제어부(102)로 Mag(n)로서 출력하는 제2 선택부(166)를 더 마련할 수도 있다. 즉, 제2 선택부(166)는 비교부(152)에서 비교된 결과를 통해 A(n)이 A(n-1)보다 제2 임계값(Th2) 이상 적거나 제1 임계값(Th1) 이상 큰 것으로 판단되면, 가산부(164)의 출력을 선택하여 이득 제어부(102)로 출력한다. 그러나, 제2 선택부(166)는 비교부(152)에서 비교된 결과를 통해 A(n)이 A(n-1)보다 제1 임계값(Th1) 이상 크지도 않고, A(n)이 A(n-1)보다 제2 임계값(Th2) 이상 적지도 않은 것으로 판단되면, 제1 버퍼(150)에서 버퍼링된 결과[Mag(n-1)]를 이득 제어부(102)로 출력한다.

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본 발명에 의한 바람직한 다른 실시예에 의하면, A(n)이 A(n-1)보다 제2 임계값(Th2) 이상 적지 않은 것으로 판단될 때, 즉, A(n)의 레벨이 A(n-1)의 레벨보다 급격하게 커졌거나 급격하게 작아지지도 않은 것으로 판단될 때, 측정된 크기[A(n)]를 전술한 수학식 1 또는 2와 같이 가변시키고, 가변된 크기[Mag(n)]를 갖는 신호를 이득 제어부(102)로 출력할 수도 있다. 이 경우, 크기 결정부(108)는 도 9에 도시된 제2 선택부(106)를 마련할 필요가 없다. 즉, 크기 결정부(108)의 제1 선택부(154)는 비교부(152)에서 비교된 결과를 통해, A(n)의 레벨이 A(n-1)의 레벨보다 급격하게 커지지도 않았고, 급격하게 작아지지도 않은 것으로 판단되면, 소정 어텍 시간(T_r)이나 소정 릴리스 시간(T_f)들 중 어느 것이나 선택적으로 출력할 수 있다.

한편, 제124, 제128 또는 제130 단계에서, 크기 결정부(108)로부터 출력되는 제m 밴드 신호의 크기[Mag(n)] 및 청각 특성을 이용하여, 제m 밴드 신호의 크기를 가변시키고, 가변된 크기를 갖는 제m 밴드 신호를 제m 변환 밴드 신호로서 결정하고, 제26 단계로 진행한다(제132 및 제134 단계들). 이를 위해, 도 6에 도시된 이득 제어부(102)는 신호 크기 조정부(100)에서 출력되는 제m 밴드 신호의 크기[Mag(n)] 및 입력단자 IN2을 통해 입력한 청각 특성을 이용하여 발생한 제m 이득 제어 신호를 증폭부(104)로 출력한다(제132 단계). 여기서, 제m 신호 변환부는 도 6에 도시된 바와 달리 신호 크기 조정부(100)를 마련하지 않을 수 있으며, 이 경우, 입력단자 IN4를 통해 입력되는 제m 밴드 신호는 이득 제어부(102)로 직접 인가된다. 그러므로, 이득 제어부(102)는 신호 크기 조정부(100)로부터 출력되는 제m 밴드 신호의 크기[Mag(n)]를 입력하는 대신에 제m BPF(72, 74, ... 또는 76)로부터 제m 밴드 신호를 직접 입력하고, 입력한 제m 밴드 신호의 크기 및 입력단자 IN2을 통해 입력한 청각 특성을 이용하여 제m 이득 제어 신호를 발생할 수도 있다. 이 때, 증폭부(104)는 입력단자 IN4를 통해 입력한 제m 밴드 신호의 크기를 이득 제어부(102)로부터 출력되는 제m 이득 제어 신호에 응답하여 가변시키고, 가변된 크기를 갖는 제m 밴드 신호를 제m 변환 밴드 신호로서 출력단자 OUT3을 통해 신호 합성부(90)로 출력한다(제134 단계).

한편, 제132 및 제134 단계들에서 수행되는 본 발명에 의한 밴드 신호 압축 과정에 대해 다음과 같이 세부적으로 살펴본다.

도 12는 본 발명에 의한 밴드 신호 압축 과정을 설명하기 위한 그래프로서, 횡축은 이득 제어부(102)로 입력되는 신호의 크기(Xm)를 나타내고, 종축은 이득 제어부(102)로부터 출력되는 신호의 크기(Ym)를 나타낸다. 여기서, 곡선(212)의 점선 부분은 비 정상적인 사용자에 대한 실질적인 청각 특성을 나타내고, 실선 부분은 비 정상적인 사용자에 대한 근사화된 청각 특성을 나타낸다.

m번째 주파수 대역에서 정상적인 사용자(210)와 청각 장애를 갖는 비 정상적인 사용자(212)의 각 HT와 UCL이 도 12에 도시된 바와 같이 주어진다고 가정하자. 이 때, 이득 제어부(102) 및 증폭부(104)는 정상적인 사용자의 다이나믹 레인지(214) 내의 크기(Xm)를 갖고 입력되는 입력 신호를 입력단자 IN2을 통해 입력되는 청각 특성에 따라 비 정상적인 사용자의 다이나믹 레인지(216) 내의 크기(Ym)를 갖는 신호로 압축시켜 출력하는 역할을 한다. 여기서, 청각 특성은 도 12에 도시된 니 포인트(knee point)들(A1, A2, A3, A4, A5 및 A6)로 이루어져 있다. 니 포인트는 X축이 제m 밴드 신호의 크기 또는 크기 결정부(108)의 출력이고, Y축이 제m 변환 밴드 신호의 크기인 X 및 Y 좌표상의 한 점에 해당한다. 여기서, A1은 정상적인 사용자의 HT에 대응하는 비 정상적인 사용자의 HT를 나타내며, A5는 정상적인 사용자의 UCL에 대응하는 비 정상적인 사용자의 UCL을 나타내며, A2, A3 및 A4들은 중간 단계의 특성을 각각 나타낸다. 도 12에서는 5개의 니 포인트들을 사용하여 청각 특성을 나타냈다. 그러나, 도 12에 도시된 청각 특성 곡선(212)의 모양과 복잡성을 고려하여, 니 포인트들의 수는 결정될 수 있다. 바람직한 니 포인트들의 개수는 일반적으로 3 ~ 4개 정도이다.

도 6에 도시된 이득 제어부(102)는 크기 결정부(108)로부터 입력되는 신호(Xm)의 크기를 입력단자 IN2을 통해 입력한 니 포인트들(A1, A2, A3, A4 및 A5)을 이용하여 보간(interpolation)하는 역할을 하며, 보간 방법으로서 여러가지가 있을 수 있다. 그 중 하나의 보간 방법인 선형 보간 방법에 대해 살펴보면 다음과 같다.

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선형 보간 방법에서는, 이득 제어부(102)는 입력한 니 포인트들을 선형적으로 연결하여 도 12에 도시된 곡선(212)의 실선 부분 즉, 비 정상적인 사용자의 근사화된 청각 특성 곡선을 만들어 낸다. 이 때, 도 12에 도시된 HT와 UCL 사이의 크기(Xm)를 갖는 입력 신호가 입력될 때, 이득 제어부(102)는 입력 신호의 크기(Xm)에 대응하는 출력[Y(Xm)]을 곡선(212)의 실선 부분을 이용하여 찾는다.

도 13은 본 발명에 의한 밴드 신호 압축 과정을 설명하기 위한 그래프로서, 횡축은 이득 제어부(102)로 입력되는 신호의 크기(Xm)를 나타내고, 종축은 이득 제어부(102)로부터 출력되는 신호의 크기(Ym)를 각각 나타낸다.

예를 들어, 이득 제어부(102)로 입력되는 신호의 레벨(Xm)이 도 13에 도시된 바와 같이 HT와 B2 사이에 존재한다고 가정한다. 이 때, 이득 제어부(102)는 Xm이 HT인 경우 사용자의 청각 특성에 맞는 출력 신호[Y(HT)]를 구하고, Xm이 B2인 경우 의 사용자의 청각 특성에 맞는 출력 신호[Y(B2)]를 구하고, Xm이 HT와 B2 사이의 값인 경우 사용자의 청각 특성에 맞는 출력 신호[Y(Xm)]를 구한다. 이득 제어부(102)는 출력 신호[Y(HT), Y(B2) 또는 Y(Xm)]에 대응하는 제m 이득 제어 신호를 증폭부(104)로 출력한다. 이 때, 증폭부(104)는 입력단자 IN4를 통해 입력한 제m 밴드 신호의 이득(Gm)을 제m 이득 제어 신호에 응답하여 제어하고, 이득이 제어된 결과[Y(HT), Y(B2) 또는 Y(Xm)]를 제m 변환 밴드 신호로서 출력단자 OUT3을 통해 출력한다.

결국, 제132 및 제134 단계에서는 니 포인트들(A1 ~ A5)을 외부로부터 입력하여, 이들을 선형적으로 연결하고, 연결된 선분으로부터 일반 방정식 Ym = sXm + I(여기서, s는 기울기를 의미하고, I는 Y축의 절편을 각각 의미한다.)을 구하며, 일반 방정식으로부터 해당하는 Xm에 대응하는 Ym을 구한다.

제24 단계후에, 신호 합성부(90)는 제1 ~ 제M 신호 변환부들(82, 84, ... 및 86)로부터 각각 출력되는 제1 ~ 제M 변환 밴드 신호들을 합성하고, 합성된 결과를 출력단자 OUT2를 통해 디지탈/아날로그 변환부(14)로 출력한다(제26 단계).

제26 단계후에, 신호 합성부(90)에서 합성된 결과인 청각 보정부(12)로부터 출력되는 변형된 크기를 갖는 디지탈 음성 신호는 디지탈/아날로그 변환부(14)에서 아날로그 음성 신호로 변환되고, 변환된 아날로그 음성 신호는 출력단자 OUT1을 통해 사용자에게 제공된다(제28 단계).

한편, 본 발명에 의한 바람직한 일 실시예에 의하면, 청각 보상부(12)는 외부에서 미리 구해진 청각 특성을 직접 인가받을 수 있다. 이 실시예에 의하면, 사용자가 심한 난청을 가질 경우에, 본 발명에 의한 개인용 무선 통신 장치는 모든 장비들이 구비된 외부의 청각 검사실에서 정확하게 측정된 이상적인 청각 특성을 이용하여 밴드 신호를 보정할 수 있다. 이 때, 청각 특성은, 후술되는 외부 인터페이스(미도시)를 통해 청각 보정부(12)로 직접 인가될 수도 있고, 키 입력부(미도시)의 키를 사용자가 직접 조작함으로서 청각 보정부(12)에 인가될 수도 있다.

본 발명의 바람직한 다른 실시예의 의하면, 청각 보상부(12)는 외부로부터 사전에 주어져서 저장된 다수개의 청각 특성들에 해당하는 소리들을 듣고서 사용자가 결정한 청각 특성을 인가받을 수 있다. 이를 위해, 도 1에 도시된 본 발명에 의한 개인용 무선 통신 장치는 다수개의 청각 특성들을 외부로부터 입력하여 저장하는 저장부(미도시) 및 저장부(미도시)에 저장된 다수개의 청각 특성들중 하나를 선택 신호에 응답하여 선택적으로 출력하는 선택부(미도시)를 더 마련할 수 있다. 여기서, 저장부(미도시)에 저장되는 청각 특성 테이블에 각 청각 특성(1, 2, 3, 4, 5, 6, ... n')은 다음 표 1과 같은 니 포인트들(A1, A2, A3, A4 및 A5)로 이루어질 수 있다.

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[표 1]

청각 특성 선택									청각 특성 변수							
F1= 500Hz			F2= 1000Hz			F3= 2000Hz			FM= XHz							
A1	A2	A3	A1	A2	A3	A1	A2	A3	A4	A5	A1	A2	A3	A4		
1	23	133	576	66	154	877	45	534	1242	3455	4568	10	30	53	100	
2	32	132	867	56	245	987	55	345	1424	3453	6758	20	40	167	238	
3	34	124	978	76	134	677	67	353	1342	3545	6865	20	45	176	567	
4	65	145	567	87	276	566	46	465	1423	3453	6786	14	42	156	865	
5	78	156	978	78	145	867	54	355	1234	3453	6866	15	56	276	348	
6	56	187	896	98	186	866	46	322	1234	3453	8666	17	23	187	297	
‖																
n'	76	167	987	78	228	867	35	214	1244	3533	7455	20	54	287	345	

표 1에서, F1, F2, ... 및 F(M) 각각은 각 주파수 대역의 중심 주파수를 나타낸다. 이 때, 사용자는 저장부(미도시)에 저장된 다수개의 청각 특성들에 해당하는 소리들을 듣고서 선택 신호를 결정함으로써, 해당하는 청각 특성이 입력단자 IN2를 통해 청각 보정부(12)로 인가되도록 한다. 여기서, 표 1에 도시된 청각 특성 테이블을 구하는 과정을 다음과 같이 살펴본다.

일반적인 사용자를 대상으로 청각 특성을 조사하면, 크게 몇 가지로 분류할 수 있다. 예컨데, 년령별 또는 사용자가 처한 환경별로 청각 특성들을 세분하여 분류할 수 있다. 즉, 고령자는 고주파의 난청과 좁은 다이나믹 레인지를 갖는 청각 특성을 갖고, 특정한 종류의 소음에 자주 노출되는 사람들은 서로 비슷한 청각 특성을 보이고, 헤드폰 등을 통해 큰 소리로 음악을 자주 듣는 사람들은 서로 비슷한 청각 특성을 보인다. 따라서, 이러한 현상을 이용하여 몇 가지의 대표적인 청각 특성들을 표 1에 보인 바와 같이 구할 수 있다.

이 때, 사용자는 저장부(미도시)에 미리 저장된 몇 가지의 청각 특성들 중에서 자기에게 맞는 청각 특성을 선택하여 본 발명에 의한 개인용 무선 통신 장치로 제공한다. 즉, 저장된 몇 가지의 청각 특성들에 상응하는 표준 음성 신호를 사용자에게 순차적으로 제공하고, 사용자는 여러개의 표준 음성 신호를 통해 자신에게 적합한 청각 특성을 선택하고, 선택된 청각 특성을 본 발명에 의한 개인용 무선 통신 장치에 인가한다.

본 발명에 의한 바람직한 또 다른 실시예에 의하면, 본 발명에 의한 개인용 무선 통신 장치는, 사용자의 청각 특성을 자체적으로 검사하는 청각 특성 검사부(미도시)를 별도로 더 마련할 수 있다. 이는, 본 발명에 의한 개인용 무선 통신 장치가 휴대 전화 장치에 적용될 경우, 휴대 전화 장치의 사용자자 자신의 청각 특성을 스스로 간단하게 검사할 수 있도록 한다. 이 경우, 청각 특성 검사부(미도시)는 청각 보정부(12)에 내장될 수도 있고, 청각 보정부(12)의 외부에 별도로 마련될 수도 있다. 또한, 청각 특성 검사부(미도시)에서 수행되는 청각 특성 검사는 도 2에 도시된 제24 단계를 수행하기 이전에 한 번만 수행하며 사용자의 청각 특성이 변하기 전까지 검사된 결과를 계속 사용한다.

이하, 본 발명에 의한 청각 특성 검사 방법과 그 방법을 수행하는 청각 특성 검사부(미도시)의 구성 및 동작을 첨부된 도면들을 참조하여 다음과 같이 설명한다.

도 14는 본 발명에 의한 청각 특성 검사 방법을 설명하기 위한 플로우차트로서, 청각 특성이 요구되면 제1 주파수 대역을 선택하는 단계(제240 및 제242 단계들), 해당하는 주파수 대역에 대한 가청 역치를 결정하는 단계(제244 ~ 제250 단계들), 해당하는 주파수 대역에 대한 니 포인트를 결정하는 단계(제252 ~ 제256 단계들), 해당하는 주파수 대역에 대한 불쾌 역치를 결정하는 단계(제258 ~ 제262 단계들) 및 해당하는 다른 주파수 대역을 결정하는 단계(제264 및 제266 단계들)로 이루어진다.

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도 15는 도 14에 도시된 청각 특성 검사 방법을 수행하는 본 발명에 의한 청각 특성 검사부의 본 발명에 의한 바람직한 일 실시예의 블럭도로서, 제1, 제2, 제3 니 포인트 결정부들(280, 282 및 284) 및 제어부(286)로 구성된다.

먼저, 제어부(286)는 청각 특성의 검사를 요구하는 청각 검사 요구 신호가 외부로부터 입력단자 IN6을 통해 입력되는가를 계속적으로 판단하고, 판단된 결과를 제어 신호로서 발생한다(제240 단계). 만일, 청각 특성의 측정이 외부로부터 요구되면, 제1 ~ 제M 주파수 대역들중에서 제1 주파수 대역을 선택한다(제242 단계). 이를 위해, 제1 니 포인트 결정부(280)는 제어부(286)로부터 발생되는 제어 신호를 통해 외부로부터 청각 특성의 검사가 요구된 것으로 인지하면, 제1 ~ 제M 주파수 대역들중 제1 주파수 대역에 해당하는 테스트 신호를 입력단자 IN5를 통해 입력한다. 여기서, 테스트 신호는 제m 주파수 대역의 중심 주파수에 해당하는 순음 신호 또는 제m 주파수 대역내의 주파수 성분이 합해진 복합 신호에 해당한다.

제242 단계후에, 제1 니 포인트 결정부(280)는 해당하는 제m 주파수 대역의 가청 역치를 결정하고, 결정된 가청 역치에 해당하는 대한 니 포인트(A1)를 출력한다(제244 ~ 제250 단계들).

이를 위해, 제242 단계후에, 제1 니 포인트 결정부(280)는 입력단자 IN5를 통해 입력한 소정의 최소 크기를 갖는 테스트 신호를 출력단자 OUT4를 통해 발생한다(제244 단계). 제244 단계후에, 사용자는 출력단자 OUT4를 통해 출력된 테스트 신호에 해당하는 소리를 들을 수 있는가를 판단한다(제246 단계). 만일, 사용자가 소리를 들을 수 없으면, 테스트 신호의 크기를 제3 소정 레벨 만큼 증가시키고, 제246 단계로 진행한다(제248 단계). 즉, 제1 니 포인트 결정부(280)는 입력단자 IN7을 통해 입력되는 제1 상태 신호를 통해 사용자가 소리를 들을 수 없는 것으로 판단되면, 테스트 신호의 크기를 제3 소정 레벨만큼 증가시키고, 증가된 레벨을 갖는 새로운 테스트 신호를 출력단자 OUT4를 통해 다시 출력하다. 따라서, 사용자는 새로운 테스트 신호에 해당하는 소리를 들을 수 있는가를 판단하고, 판단된 결과를 제1 상태 신호로서 입력단자 IN7을 통해 제1 니 포인트 결정부(280)에 인가한다. 그러나, 제1 니 포인트 결정부(280)는 입력단자 IN7을 통해 입력한 제1 상태 신호를 통해 사용자가 소리를 들을 수 있는 것으로 판단되면, 들리는 소리에 해당하는 테스트 신호의 크기를 가청 역치로 결정하고, 가청 역치에 해당하는 니 포인트(A1)를 출력한다(제250 단계).

제250 단계후에, 제2 니 포인트 결정부(282)는 사용자에게 편안한 느낌을 제공하는 제m 주파수 대역의 니 포인트를 결정하고, 결정된 니 포인트(A3)를 출력한다(제252 ~ 제256 단계들).

이를 위해, 제250 단계후에, 사용자는 출력단자 OUT5를 통해 출력되는 테스트 신호에 해당하는 소리가 편안한 느낌을 제공하는가를 판단한다(제252 단계). 만일, 테스트 신호에 해당하는 소리가 편안한 느낌을 제공하지 않으면, 테스트 신호의 크기를 제4 소정 레벨만큼 증가시키고, 제252 단계로 진행한다(제254 단계). 즉, 제2 니 포인트 결정부(282)는 입력단자 IN8을 통해 입력되는 제2 상태 신호를 통해 사용자가 편안한 느낌을 제공받을 수 없는 것으로 판단되면, 테스트 신호의 크기를 제4 소정 레벨만큼 증가시키고, 증가된 레벨을 갖는 새로운 테스트 신호를 출력단자 OUT5를 통해 다시 출력하다. 따라서, 사용자는 새로운 테스트 신호에 해당하는 소리가 편안한 느낌을 제공하는가를 판단하고, 판단된 결과를 입력단자 IN8을 통해 제2 상태 신호로서 제2 니 포인트 결정부(282)에 인가한다. 그러나, 제2 니 포인트 결정부(282)는 입력단자 IN8을 통해 입력한 제2 상태 신호에 응답하여 사용자가 소리로부터 편안한 느낌을 제공받은 것으로 판단되면, 편안한 느낌을 제공하는 소리에 해당하는 테스트 신호의 크기를 이용하여 결정한 니 포인트(A3)를 출력한다(제256 단계). 여기서, 제2 니 포인트 결정부(282)는 제256 단계에서 결정된 니 포인트(A3)에 해당하는 소리보다 약간 작은 소리에 해당하는 니 포인트(A2) 및 약간 큰 소리에 해당하는 니 포인트(A4)를 부가적으로 더 결정할 수도 있다. 그러나, 임상적으로 니 포인트들을 5개 이상 결정하는 것은 의미가 적으며, 측정하기도 어렵다. 따라서, 니 포인트는 세 개(A1, A3 및 A5)가 바람직하다.

제256 단계후에, 제3 니 포인트 결정부(284)는 제m 주파수 대역의 불쾌 역치에 해당하는 니 포인트를 결정하고, 결정된 니 포인트(A5)를 출력한다(제258 ~ 제262 단계들).

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이를 위해, 제256 단계후에, 사용자는 출력단자 OUT6을 통해 출력되는 테스트 신호에 해당하는 소리가 너무 큰가를 판단한다(제258 단계). 즉, 사용자는 소리가 너무 커서 제대로 들리지 않는가, 소리가 너무 커서 귀가 아픈가 혹은 더 이상의 큰 소리가 출력되지 않았으면 좋겠다는 느낌을 받는가를 판단한다. 만일, 테스트 신호에 해당하는 소리가 너무 크지 않으면, 테스트 신호의 크기를 제5 소정 레벨만큼 증가시키고, 제258 단계로 진행한다(제260 단계). 즉, 제3 니 포인트 결정부(284)는 입력단자 IN9를 통해 입력되는 제3 상태 신호를 통해 소리가 너무 크지 않은 것으로 사용자가 판단하였다고 인식되면, 테스트 신호의 크기를 제5 소정 레벨만큼 증가시키고, 증가된 레벨을 갖는 새로운 테스트 신호를 출력단자 OUT6을 통해 다시 출력하다. 따라서, 사용자는 새로운 테스트 신호에 해당하는 소리가 너무 큰가를 판단하고, 판단된 결과를 입력단자 IN9를 통해 제3 상태 신호로서 제3 니 포인트 결정부(284)에 인가한다. 그러나, 제3 니 포인트 결정부(284)는 입력단자 IN9를 통해 입력한 제3 상태 신호를 통해 소리가 너무 큰 것으로 사용자가 판단하였다고 인식되면, 너무 큰 소리에 해당하는 테스트 신호의 크기를 불쾌역치로 결정하고, 결정한 불쾌역치에 해당하는 니 포인트(A5)를 출력한다(제262 단계).

제262 단계후에, 제어부(286)는 해당하는 제m 주파수 대역이 마지막 주파수 대역인 제M 주파수 대역인가를 판단하고 판단된 결과를 제1, 제2 및 제3 니 포인트 결정부들(280, 282 및 284)로 출력한다(제264 단계). 만일, 제m 주파수 대역이 제M 주파수 대역이면, 청각 특성 검사를 종료한다. 이를 위해, 제어부(286)는 더 이상 니 포인트들이 결정되지 않도록 제1, 제2 및 제3 니 포인트 결정부들(280, 282 및 284)을 제어한다. 즉, 제어부(286)는 테스트 신호가 제1, 제2 및 제3 니 포인트 결정부들(280, 282 및 284)에 인가되지 않도록 한다. 그러나, 제m 주파수 대역이 제M 주파수 대역이 아니면, m은 1만큼 증가되고, 제244 단계로 진행한다(제266 단계). 즉, 제m+1 주파수 대역에 대하여 제244 ~ 제262 단계들이 수행될 수 있도록 한다. 이 때, 제어부(286)는 해당하는 니 포인트를 발생하도록 제1, 제2 및 제3 니 포인트 결정부들(280, 282 및 284)을 제어한다. 즉, 제어부(286)는 제m+1 주파수 대역에 대한 테스트 신호가 입력단자 IN5를 통해 각 니 포인트 결정부에 입력되도록 제어한다.

여기서, 제1, 제2 및 제3 니 포인트 결정부들(280, 282 및 284)들에 입력되는 제m 주파수 대역에 대한 테스트 신호는 입력단자 IN5을 통해 외부로부터 인가될 수도 있고, 제어부(286)로부터 각 니 포인트 결정부에 직접 인가될 수도 있다.

이하, 도 1에 도시된 개인용 무선 통신 장치가 휴대용 전화 장치에 해당할 경우, 본 발명에 의한 청각 보정 기능을 갖는 휴대용 전화 장치의 구성 및 동작을 다음과 같이 설명한다.

도 16은 본 발명에 의한 청각 보정 기능을 갖는 휴대용 전화 장치의 블럭도로서, 마이크(302) 따위로 구현될 수 있는 음성 입력부(300), 스피커(306) 따위로 구현될 수 있는 음성 출력부(304), 아날로그/디지탈 변환부(ADC:Analog to Digital Converter)(310), DAC(14), 부호부(316), 복호부(10), 중앙 처리부(322), 변복조부(324), 청각 보정부(12), 표시부(328), 키 입력부(326) 및 입/출력부(330)로 구성된다.

도 16 및 도 1에 도시된 복호부(10), 청각 보정부(12) 및 DAC(14)는 동일하며, 동일한 기능을 수행한다. 또한, 입/출력부(330)는 전술한 외부 인터페이스부의 역할을 수행한다.

도 16에 도시된 음성 입력부(300)는 사용자로부터 입력한 음성을 아날로그 형태의 음성 신호로 변환하여 ADC(310)로 출력하며, 이를 위해 마이크(302)로 구현될 수 있다. 이 때, ADC(310)는 음성 입력부(300)로부터 출력되는 아날로그 형태의 음성 신호를 디지탈 형태로 변환하고, 변환된 결과를 부호부(316)로 출력한다. 부호부(316)는 ADC(310)의 출력을 부호화하고, 부호화된 결과를 중앙 처리부(322)로 출력한다. 여기서, 중앙 처리부(322)는 부호부(316)에서 부호화된 결과에 헤더(header) 또는 에러 정정 부호 따위의 부가 정보를 추가하여 변복조부(324)로 출력한다. 변복조부(324)는 중앙 처리부(322)로부터 출력되는 신호를 변조하고, 변조된 결과를 출력단자 OUT7을 통해 안테나(미도시)를 통하여 무선(RF:Radio Frequency) 신호로서 송출한다.

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한편, 변복조부(324)는 안테나(미도시)를 통해 수신되어 입력단자 IN10을 통해 입력한 아날로그 음성 신호를 복조하고, 복조된 결과를 중앙 처리부(322)로 출력한다. 중앙 처리부(322)는 복조된 결과로부터 필요한 정보만을 취한 다음에, 복호부(10)로 출력한다. 복호부(10)는 전술한 바와 같이, 음성 신호를 복호화하고, 복호화된 결과를 청각 보정부(12)로 출력한다. 청각 보정부(12)는 중앙 처리부(322)로부터 출력되는 청각 보정 요구 신호에 응답하여 복호화된 결과의 크기를 변형시켜 DAC(14)로 출력한다. 여기서, 키 입력부(326)는 사용자가 청각 보정을 요구할 때 제1 키 입력 신호를 중앙 처리부(322)로 출력하고, 중앙 처리부(322)는 키 입력부(326)로부터 발생되는 제1 키 입력 신호에 응답하여 청각 보정 요구 신호를 청각 보정부(12)로 출력한다. 그러므로, 외부에서 청각 보정이 요구될 때 청각 보정부(12)는 복호화된 결과를 전술한 바와 같이 압축한 후에 DAC(14)로 출력하지만, 외부에서 청각 보정을 요구하지 않으면 복호화된 결과를 압축하지 않고 그대로 DAC(14)로 출력한다. 이 때, 청각 보정부(12)는 전술한 바와 같이 외부 인터페이스부(미도시)에 해당하는 입/출력부(330)를 통해 입력된 사용자의 청각 특성을 중앙 처리부(322)를 거쳐 입력할 수 있다.

DAC(14)는 청각 보정부(12)로부터 출력되는 디지탈 형태의 신호를 아날로그 형태 신호로 변환하여 음성 출력부(304)로 출력한다. 이 때, 음성 출력부(304)는 DAC(14)로부터 출력되는 아날로그 형태의 음성 신호를 사용자에게 소리로서 제공하며, 이를 위해, 스피커(306)로 구현될 수 있다. 여기서, 키 입력부(326)는 사용자가 청각 특성의 검사를 요구할 때 제2 키 입력 신호를 발생하여 중앙 처리부(322)로 출력한다. 이 때, 중앙 처리부(322)는 제2 키 입력 신호에 응답하여 청각 검사 요구 신호를 청각 특성 검사부(미도시)로 출력한다. 따라서, 외부에 별도로 마련되거나 청각 보정부(12) 또는 중앙 처리부(322)에 내장될 수 있는 청각 특성 검사부(미도시)는 청각 검사 요구 신호에 응답하여 전술한 도 14에 도시된 청각 특성을 검사 방법을 수행한다. 또한, 도 16에 도시된 중앙 처리부(322)는 도 16에 도시된 장치의 현재 상태를 표시부(328) 또는 입/출력부(330)를 통해 사용자에게 제공할 수도 있다. 도 16에 도시된 ADC(310) 및 DAC(14)는 일반적인 휴대폰의 코덱(CODEC:COder- DECoder)에 해당하고, 부호부(316) 및 복호부(10)는 일반적인 휴대폰의 보코더(VOCODER)에 해당한다.

발명의 효과

이상에서 설명한 바와 같이, 본 발명에 의한 청각 보정 기능을 갖는 개인용 무선 통신 장치 및 방법은 소리는 최종적으로 개인의 청각 특성에 의하여 인지되는 것이므로, 입력되는 신호를 청각 장애를 갖는 사용자 또는 청각 장애를 갖지 않지만 서로 다른 청각 특성들을 갖는 사용자들 개개인의 청각 특성에 적합하게 보정하여 사용자에게 편안하고 변별력 있는 소리를 제공할 수 있는 효과를 갖는다.

(57) 청구의 범위

청구항 1.

외부로부터 수신되어 복조된 디지탈 음성 신호를 복호화하고, 복호화된 결과를 출력하는 복호부;

상기 복호부로부터 입력한 상기 복호화된 결과의 크기를 사용자의 청각 특성에 상응하여 변형시키고, 변형된 크기를 갖는 디지탈 음성 신호를 출력하는 청각 보정부; 및

상기 청각 보정부로부터 출력되는 상기 디지탈 음성 신호를 아날로그 음성 신호로 변환하여 상기 사용자에게 제공하는 디지탈/아날로그 변환부를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 2.

제1 항에 있어서, 청각 보정부는

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상기 복호화된 결과를 원하는 주파수 대역별로 필터링하고, 필터링된 결과들을 제1 ~ 제M 밴드 신호들로서 출력하는 제1 ~ 제M 대역 통과 필터들;

상기 제1 ~ 제M 밴드 신호들 각각의 크기를 측정하고, 상기 측정된 크기들 각각을 상기 청각 특성에 상응하여 변형시키고, 변형된 크기들을 갖는 밴드 신호들을 제1 ~ 제M 변환 밴드 신호들로서 출력하는 제1 ~ 제M 신호 변환부들; 및

상기 제1 ~ 제M 변환 밴드 신호들을 합성하고, 합성된 결과를 출력하는 신호 합성부를 구비하고,

상기 합성된 결과는 상기 디지탈/아날로그 변환부에서 아날로그 신호로 변환되어 상기 사용자에게 제공되는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 3.

제2 항에 있어서, 상기 제m($1 \le m \le M$) 신호 변환부는

상기 제m 밴드 신호의 크기를 측정하고, 측정된 크기의 변화 정도를 감지하며, 상기 감지된 결과에 응답하여 상기 제m 밴드 신호의 크기를 점차적으로 커지게 하거나 작아지게 하여 출력하는 신호 크기 조정부;

상기 신호 크기 조정부에서 최종적으로 커졌거나 작아진 크기를 갖는 상기 제m 밴드 신호의 크기 및 상기 청각 특성을 이용하여 제m 이득 제어 신호를 출력하는 이득 제어부; 및

상기 제m 밴드 신호의 크기를 상기 제m 이득 제어 신호에 응답하여 가변시키고, 가변된 크기를 갖는 제m 밴드 신호를 상기 제m 변환 밴드 신호로서 출력하는 증폭부를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 4.

제3 항에 있어서, 상기 신호 크기 조정부는

상기 제m 밴드 신호의 크기를 측정하여 출력하는 크기 측정부; 및

상기 제m 밴드 신호에 대해 상기 크기 측정부에서 어느 샘플 시간(n)에서 측정된 크기[A(n)]를 한 샘플 이전 시간(n-1)에 측정된 크기[A(n-1)]와 비교하고, 상기 감지된 결과에 해당하는 비교된 결과에 응답하여 상기 제m 밴드 신호의 크기를 점차적으로 크게하거나 작아지게 하여 상기 이득 제어부로 출력하는 크기 결정부를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 5.

제4 항에 있어서, 상기 크기 측정부는 상기 제m 밴드 신호의 절대값을 측정하고, 상기 절대값을 상기 제m 밴드 신호의 측정된 크기로서 상기 크기 결정부로 출력하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 6.

제5 항에 있어서, 상기 크기 결정부는

상기 크기 측정부의 출력을 입력하여 버퍼링하는 제1 버퍼;

상기 크기 측정부의 출력[A(n)]과 상기 제1 버퍼에서 버퍼링된 결과[A(n-1)]를 비교하고, 비교된 결과들을 상기 감지된 결과들로서 출력하는 비교부;

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소정 어텍 시간 또는 소정 릴리스 시간중 하나를 상기 비교부에서 비교된 결과에 응답하여 선택적으로 출력하는 제1 선택부;

제1 승산부;

소정값으로부터 상기 제1 선택부의 출력을 감산하고, 감산된 결과를 출력하는 감산부;

상기 감산부의 출력과 상기 크기 측정부의 출력[A(n)]을 승산하고, 승산된 결과를 출력하는 제2 승산부;

상기 제1 및 상기 제2 승산부들에서 승산된 결과들을 가산하고, 가산된 결과를 어느 샘플 시간(n)에서 가변된 크기[Mag(n)]로서 출력하는 가산부; 및

상기 가산부의 출력을 버퍼링하고, 버퍼링된 결과를 상기 제1 승산부로 출력하는 제2 버퍼를 구비하고,

상기 제1 승산부는 상기 제2 버퍼에서 버퍼링된 결과와 상기 제1 선택부의 출력을 승산하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 7.

제6 항에 있어서, 상기 크기 결정부는

상기 가산부의 출력 또는 상기 제1 버퍼에서 버퍼링된 결과[A(n- 1)]중 하나를 상기 비교부에서 비교된 결과에 응답하여 선택적으로 상기 이득 제어부로 출력하는 제2 선택부를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 8.

제6 항 또는 제7 항에 있어서, 상기 소정 어텍 시간은 상기 크기 측정부의 출력에 대한 상기 크기 결정부의 출력이 안정화될 때의 레벨보다 제1 소정 레벨만큼 높은 레벨에 도달할 때 까지 소요되는 시간인 T_r에 해당하고, 상기 소정 릴리스 시간은 상기 크기 측정부의 출력에 대한 상기 크기 결정부의 출력이 안정화될 때의 레벨보다 제2 소정 레벨만큼 낮은 레벨에 도달할 때 까지 소요되는 시간인 T_f에 해당하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 9.

제1 항에 있어서, 상기 개인용 무선 통신 장치는

상기 사용자의 청각 특성을 외부로부터 입력하여 상기 청각 보정부로 출력하는 외부 인터페이스부를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 10.

제2 항에 있어서, 상기 개인용 무선 통신 장치는

상기 사용자의 청각 특성을 자체적으로 검사하는 청각 특성 검사부를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 11.

제1 항에 있어서, 상기 개인용 무선 통신 장치는

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다수개의 상기 청각 특성들에 대한 정보를 갖는 청각 특성 테이블을 미리 입력하여 저장하는 저장부; 및

상기 저장부에 저장된 상기 청각 특성 테이블에서 하나의 청각 특성을 선택 신호에 응답하여 선택적으로 출력하는 제3 선택부를 더 구비하고,

상기 사용자는 상기 다수개의 청각 특성들에 해당하는 소리들을 듣고서 상기 선택 신호를 결정하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 12.

제2 항 또는 제10 항에 있어서, 상기 제m 신호 변환부는

상기 청각 특성을 나타내는 니 포인트(knee point)들을 선형적으로 연결하고, 연결된 선상에서 상기 제m 밴드 신호의 크기에 해당하는 상기 제m 변환 밴드 신호의 크기를 찾고,

상기 니 포인트는 X축이 상기 제m 밴드 신호의 크기이고, Y축이 상기 제m 변환 밴드 신호의 크기인 X 및 Y 좌표상의 한점에 해당하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 13.

제12 항에 있어서, 상기 청각 특성 검사부는

상기 제1 ~ 제M 상기 밴드 신호들에 해당하는 제1 ~ 제M 주파수 대역들중 제어 신호에 응답하여 입력한 상기 제m 주파수 대역의 가청 역치를 결정하고, 결정된 상기 가정 역치에 해당하는 니 포인트를 출력하는 제1 니 포인트 결정부;

상기 제m 주파수 대역의 상기 사용자에게 편안한 느낌을 제공하는 니 포인트(들)를 결정하고, 결정된 상기 니 포인트(들)를 출력하는 제2 니 포인트 결정부;

상기 제m 주파수 대역의 불쾌 역치를 결정하고, 결정된 상기 불쾌 역치에 해당하는 니 포인트를 출력하는 제3 니 포인트 결정부; 및

상기 사용자가 청각 특성의 검사를 요구하는가에 상응하여 상기 제어 신호를 발생하고, 상기 제1 ~ 제M 주파수 대역들에 대한 상기 니 포인트들이 모두 구해졌는가에 상응하여 상기 제1, 상기 제2 및 상기 제3 니 포인트 결정부들의 상기 니 포인트 결정을 제어하는 제어부를 구비하고, 상기 청각 특성은 상기 니 포인트들로 이루어지는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 14.

제13 항에 있어서, 상기 제2 니 포인트 결정부는

출력하는 상기 니 포인트에 해당하는 소리보다 약간 작은 소리에 해당하는 니 포인트 및 약간 큰 소리에 해당하는 니 포인트를 부가적으로 더 결정하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 15.

제1 항, 제9 항, 제10 항 또는 제11 항에 있어서, 상기 개인용 무선 통신 장치는

상기 사용자로부터 입력한 음성을 아날로그 형태의 음성 신호로 변환하여 출력하는 음성 입력부;

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아날로그 형태의 상기 음성 신호를 디지탈 형태로 변환하고, 변환된 결과를 출력하는 아날로그/디지탈 변환부;

상기 아날로그/디지탈 변환부의 출력을 부호화하여 출력하는 부호부;

상기 부호화된 결과를 변조하는 변조부;

외부로부터 수신한 음성 신호를 복조하고, 복조된 결과를 출력하는 복조부;

상기 디지탈/아날로그 변환부로부터 출력되는 상기 아날로그 음성 신호를 상기 사용자에게 소리로서 제공하는 음성 출력부;

상기 부호화된 결과를 입력하여 상기 변조부로 제공하고, 상기 복조된 결과를 입력하여 상기 복조된 디지탈 음성 신호로서 상기 복호부로 출력하고, 제1 키 입력 신호에 응답하여 청각 보정 요구 신호를 출력하는 중앙 처리부; 및

상기 사용자가 청각 보정을 요구할 때 상기 제1 키 입력 신호를 출력하는 키 입력부를 더 구비하고,

상기 청각 보정부는 상기 복호화된 결과의 크기를 상기 청각 보정 요구 신호에 응답하여 변형시키는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 16.

제15 항에 있어서, 상기 개인용 무선 통신 장치에서

상기 키 입력부는 상기 사용자가 상기 청각 특성의 검사를 요구할 때 제2 키 입력 신호를 발생하고, 상기 중앙 처리부는 상기 제2 키 입력 신호에 응답하여 청각 검사 요구 신호를 출력하고, 상기 청각 특성 검사부는 상기 청각 검사 요구 신호에 응답하여 상기 청각 특성을 검사하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 장치.

청구항 17.

(a) 외부로부터 수신되어 복조된 디지탈 음성 신호를 복호화하는 단계;

(b) 상기 복호화된 결과의 신호의 크기를 사용자의 청각 특성에 상응하여 변형시켜, 변형된 크기를 갖는 디지탈 음성 신호를 구하는 단계; 및

(c) 상기 변형된 크기를 갖는 상기 디지탈 음성 신호를 아날로그 음성 신호로 변환하여 상기 사용자에게 제공하는 단계를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 18.

제17 항에 있어서, 상기 (b) 단계는

(b1) 상기 (a) 단계에서 복호화된 결과를 원하는 주파수 대역별로 나누어 제1 ~ 제M 밴드 신호들을 구하는 단계;

(b2) 상기 제1 ~ 제M 밴드 신호들 각각의 크기를 상기 청각 특성에 상응하여 변형시키고, 변형된 크기들을 갖는 밴드 신호들인 제1 ~ 제M 변환 밴드 신호들을 구하는 단계; 및

(b3) 상기 제1 ~ 제M 변환 밴드 신호들을 합성하고, 상기 (c) 단계로 진행하는 단계를 구비하고,

상기 합성된 결과는 아날로그 신호로 변환되어 사용자에게 제공되는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

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청구항 19.

제18 항에 있어서, 상기 (b2) 단계는 각 제m($1 \le m \le M$) 밴드 신호에 대하여,

(b21) 상기 (b1) 단계후에, 상기 제m 밴드 신호의 크기를 측정하는 단계;

(b22) 상기 측정된 크기의 변화 정도에 상응하여 상기 제m 밴드 신호의 크기를 점차적으로 커지게 하거나 작아지게 하는 단계; 및

(b23) 상기 (b22) 단계에서 최종적으로 커지거나 작아진 크기를 갖는 제m 밴드 신호의 크기 및 상기 청각 특성을 이용하여, 상기 제m 밴드 신호의 크기를 가변시키고, 가변된 크기를 갖는 제m 밴드 신호를 상기 제m 변환 밴드 신호로서 결정하고, 상기 (b3) 단계로 진행하는 단계를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 20.

제19 항에 있어서, 상기 (b22) 단계는

상기 제m 밴드 신호에 대해 어느 샘플 시간(n)에서 측정된 크기[A(n)]가 한 샘플 이전 시간(n-1)에서 측정된 크기[A(n-1)]보다 제1 임계값 이상 큰가를 판단하는 단계;

상기 A(n)가 상기 A(n-1)보다 상기 제1 임계값 이상 크면, 아래와 같이 상기 측정된 크기[A(n)]를 점차적으로 작아지게 하여, 최종적으로 작아진 크기[Mag(n)]를 갖는 제m 밴드 신호를 구하고 상기 (b23) 단계로 진행하는 단계;

$$Mag(n)=T_r*Mag(n-1)+(1-T_r)*A(n)$$

(여기서, T_r는 상기 제m 밴드 신호의 측정된 크기에 대한 상기 제m 밴드 신호의 크기가 최종적으로 작아질 때의 레벨보다 제1 소정 레벨만큼 높은 레벨에 도달할 때 까지 소요되는 시간을 의미한다.)

상기 A(n)가 상기 A(n-1)보다 상기 제1 임계값 이상 크지 않으면, 상기 A(n)이 상기 A(n-1)보다 제2 임계값 이상 적은가를 판단하는 단계; 및

상기 A(n)이 상기 A(n-1)보다 상기 제2 임계값 이상 적으면, 아래와 같이 상기 측정된 크기[A(n)]를 점차적으로 커지게 하여, 최종적으로 커진 크기[Mag(n)]를 갖는 제m 밴드 신호를 구하고 상기 (b23) 단계로 진행하는 단계를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

$$Mag(n)=T_f*Mag(n-1)+(1-T_f)*A(n)$$

(여기서, T_f는 상기 제m 밴드 신호의 측정된 크기에 대한 상기 제m 밴드 신호의 크기가 최종적으로 커졌을 때의 레벨보다 제2 소정 레벨만큼 낮은 레벨에 도달할 때 까지 소요되는 시간을 의미한다.)

청구항 21.

제20 항에 있어서, 상기 (b22) 단계는

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상기 A(n)이 상기 A(n-1)보다 상기 제2 임계값 이상 적지 않으면, 한 샘플 이전 시간(n-1)에서 최종적으로 커졌거나 작아진 크기[Mag(n-1)]를 어느 샘플 시간(n)에서 최종적으로 커졌거나 작아진 크기[Mag(n)]로서 결정하고, 상기 (b23) 단계로 진행하는 단계를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 22.

제20 항에 있어서, 상기 (b22) 단계는

상기 A(n)이 상기 A(n-1)보다 상기 제2 임계값 이상 적지 않으면, 아래와 같이 상기 측정된 크기[A(n)]를 가변시켜, 가변된 크기[Mag(n)]를 갖는 밴드 신호를 구하고 상기 (b23) 단계로 진행하는 단계를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

$$Mag(n)=T_1*Mag(n-1)+(1-T_1)*A(n)$$

청구항 23.

제20 항에 있어서, 상기 (b22) 단계는

상기 A(n)이 상기 A(n-1)보다 상기 제2 임계값 이상 적지 않으면, 아래와 같이 상기 측정된 크기[A(n)]를 가변시켜, 가변된 크기[Mag(n)]를 갖는 밴드 신호를 구하고 상기 (b23) 단계로 진행하는 단계를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

$$Mag(n)=T_f*Mag(n-1)+(1-T_f)*A(n)$$

청구항 24.

제18 항에 있어서, 상기 사용자의 청각 특성은 외부로부터 주어지는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 25.

제18 항에 있어서, 상기 개인용 무선 통신 방법은

상기 사용자의 청각 특성을 자체적으로 검사하고, 상기 (b) 단계로 진행하는 (d) 단계를 더 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 26.

제18 항에 있어서, 상기 사용자의 청각 특성은

외부로부터 사전에 주어지는 다수개의 청각 특성들중에서, 상기 다수개의 청각 특성들에 해당하는 소리들을 듣고서 사용자가 결정한 청각 특성에 해당하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 27.

제25 항에 있어서, 상기 (d) 단계는

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(d1) 상기 청각 특성의 측정이 요구되는가를 계속적으로 판단하는 단계;

(d2) 상기 청각 특성의 측정이 요구되면, 상기 제1 ~ 제M 주파수 대역들중에서 제1 주파수 대역을 선택하는 단계;

(d3) 해당하는 제m 주파수 대역의 가청 역치에 해당하는 대한 니 포인트(knee point)를 결정하는 단계;

(d4) 상기 제m 주파수 대역의 상기 사용자에게 편안한 느낌을 제공하는 니 포인트들을 결정하는 단계;

(d5) 상기 제m 주파수 대역의 불쾌 역치에 해당하는 니 포인트를 결정하는 단계;

(d6) 상기 해당하는 제m 주파수 대역이 마지막인 제M 주파수 대역인가를 판단하여, 상기 제m 주파수 대역이 상기 제M 주파수 대역이면, 상기 (b) 단계로 진행하는 단계; 및

(d7) 상기 제m 주파수 대역이 상기 제M 주파수 대역이 아니면, m을 1만큼 증가시키고, 상기 (d3) 단계로 진행하는 단계를 구비하고,

상기 청각 특성은 상기 니 포인트들로 이루어지는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 28.

제27 항에 있어서, 상기 (d3) 단계는

(d31) 소정의 최소 크기를 갖는 테스트 신호를 발생하는 단계;

(d32) 상기 사용자가 상기 테스트 신호에 해당하는 소리를 들을 수 있는가를 판단하는 단계;

(d33) 상기 사용자가 상기 소리를 들을 수 없으면, 상기 테스트 신호의 크기를 제3 소정 레벨 만큼 증가시키고, 상기 (d32) 단계로 진행하는 단계; 및

(d34) 상기 사용자가 상기 소리를 들을 수 있으면, 들리는 소리에 해당하는 상기 테스트 신호의 크기를 상기 가청 역치로서 결정하고, 상기 가청 역치를 이용하여 상기 가정 역치에 대한 니 포인트를 결정하고, 상기 (d4) 단계로 진행하는 단계를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 29.

제28 항에 있어서, 상기 (d4) 단계는

(d41) 상기 (d3) 단계후에, 상기 사용자는 상기 테스트 신호에 해당하는 소리가 편안한 느낌을 제공하는가를 판단하는 단계;

(d42) 상기 소리가 편안한 느낌을 제공하지 않으면, 상기 테스트 신호의 크기를 제4 소정 레벨만큼 증가시키고, 상기 (d41) 단계로 진행하는 단계; 및

(d43) 상기 소리가 편안한 느낌을 제공하면, 편안한 느낌을 제공하는 소리에 해당하는 상기 테스트 신호의 크기를 이용하여 상기 니 포인트를 결정하고, 상기 (d5) 단계로 진행하는 단계를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

청구항 30.

제29 항에 있어서, 상기 (d5) 단계는

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(d51) 상기 (d4) 단계후에, 상기 사용자는 상기 테스트 신호에 해당하는 소리가 너무 큰가를 판단하는 단계;

(d52) 상기 소리가 너무 크지 않으면, 상기 테스트 신호의 크기를 제5 소정 레벨만큼 증가시키고, 상기 (d51) 단계로 진행하는 단계; 및

(d53) 상기 소리가 너무 크면, 너무 큰 소리에 해당하는 상기 테스트 신호의 크기를 상기 불쾌 역치로 결정하고, 상기 불쾌 역치를 이용하여 상기 니 포인트를 결정하고 상기 (d6) 단계로 진행하는 단계를 구비하는 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

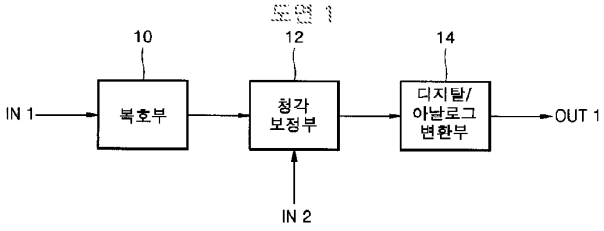
청구항 31.

제28 항, 제29 항 또는 제30 항에 있어서, 상기 테스트 신호는

상기 제m 주파수 대역의 중심 주파수에 해당하는 순음 신호 또는 제m 주파수 대역내의 주파수 성분이 합해진 복합 신호인 것을 특징으로 하는 청각 보정 기능을 갖는 개인용 무선 통신 방법.

도면

도면 1



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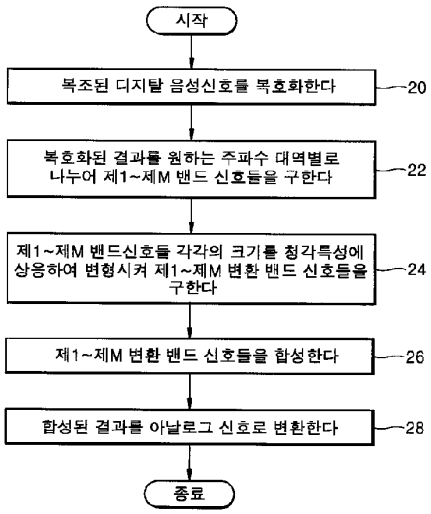

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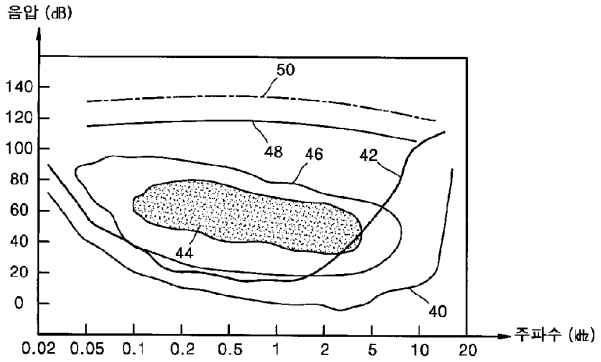

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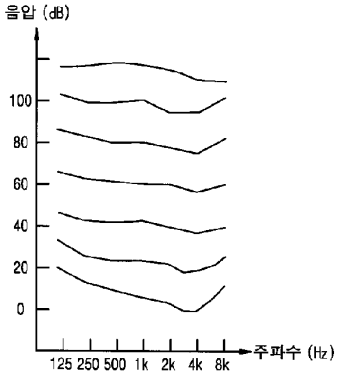

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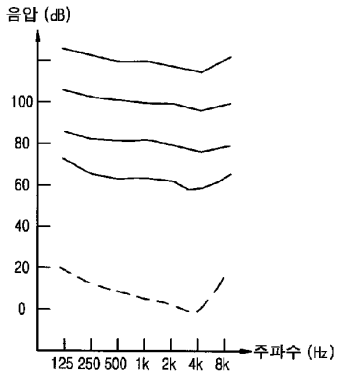
도면 4b



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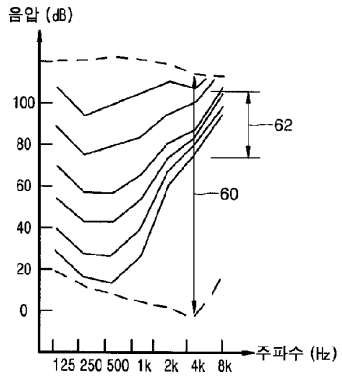

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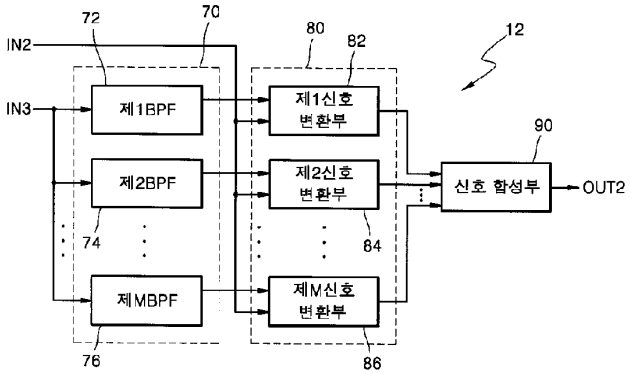

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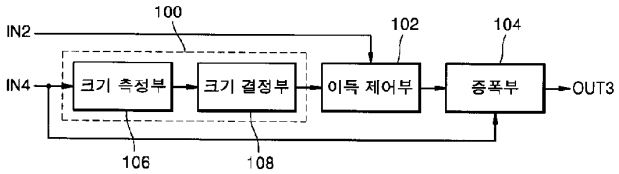

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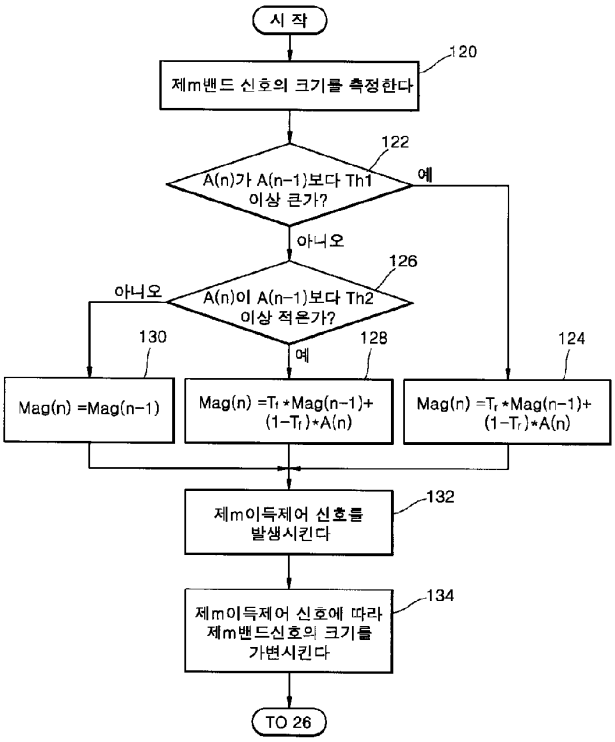

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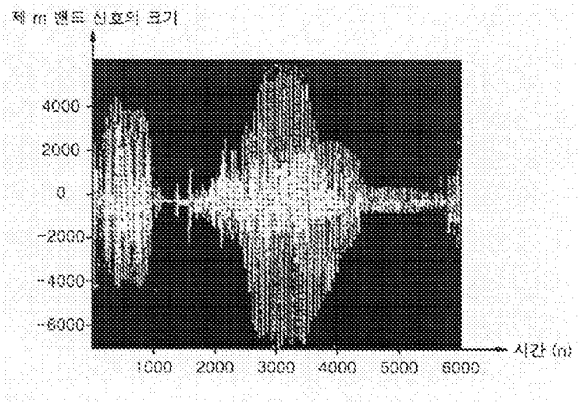

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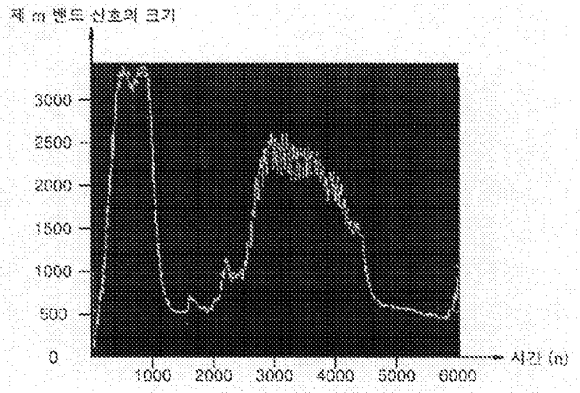

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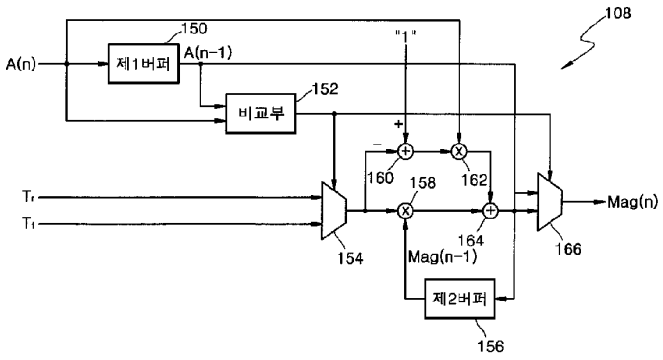

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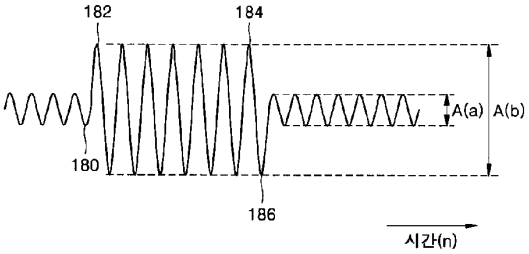

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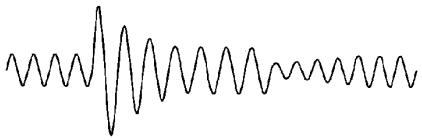

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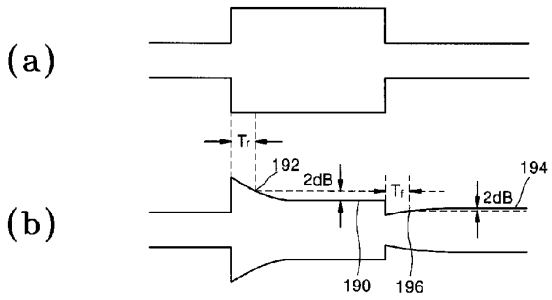

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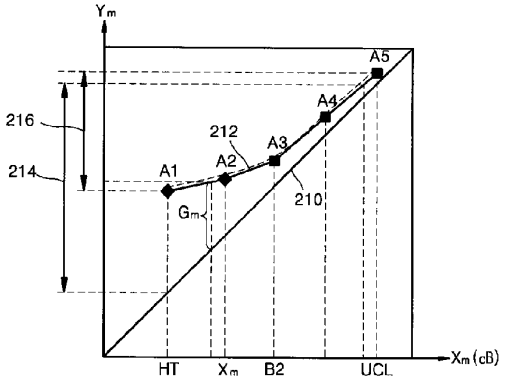

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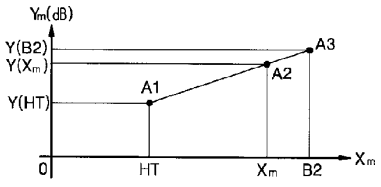

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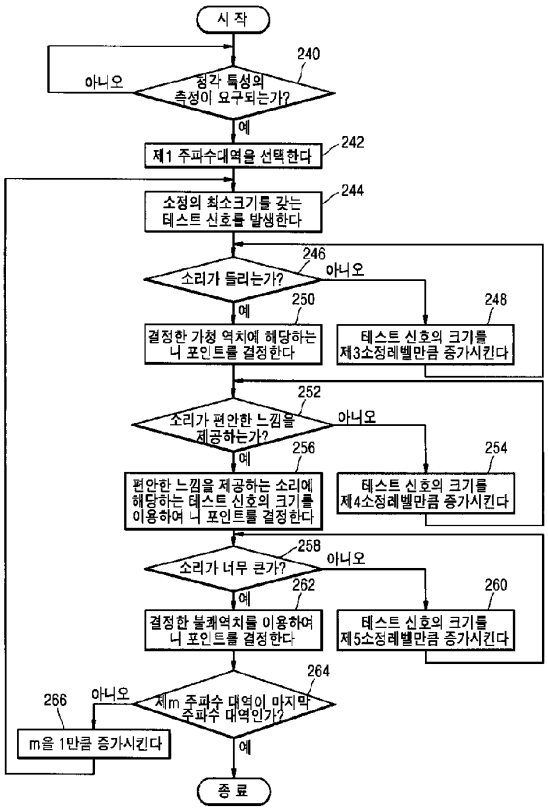

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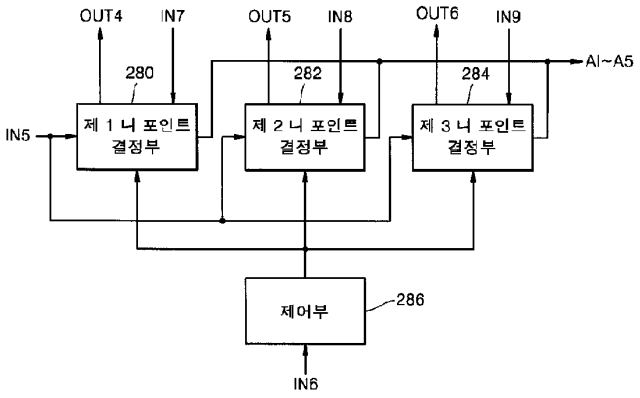

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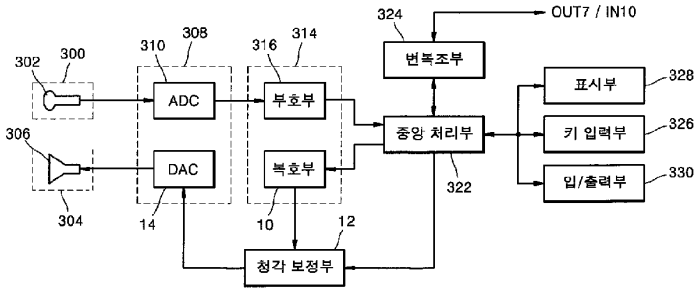

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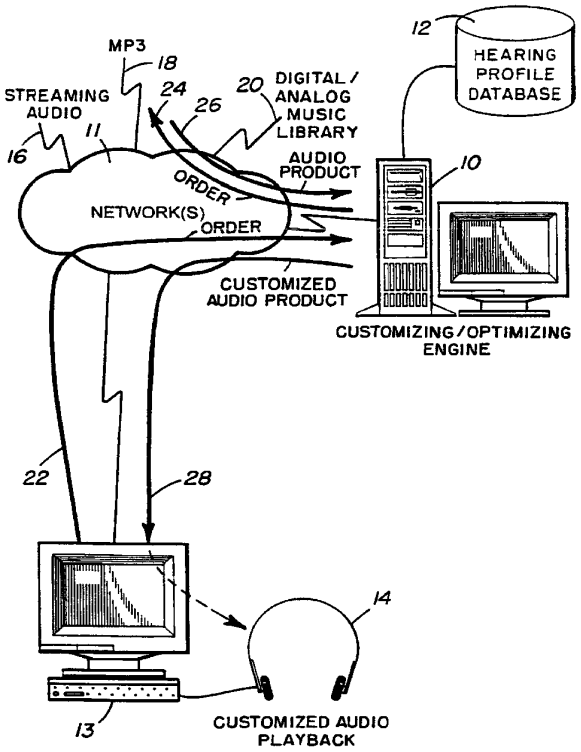
[Continued on next page]

(54) Title: PRODUCING AND STORING HEARING PROFILES AND CUSTOMIZED AUDIO DATA BASED



(57) Abstract: A method for providing customized audio data products that includes the steps of (1) storing a machine readable hearing profile for a customer, (2) accepting via a data input device or data network for example, machine readable orders from the customer for a particular audio data product, (3) associating the hearing profile for the customer with the particular audio data product, (4) modifying the particular audio data product according to the hearing profile to produce a customized audio data product, (5) delivering the customized audio data product to the customer, for example via a network or by a machine readable storage medium, (6) accepting feedback from the customer concerning the objective or subjective performance of the customized audio data product, and (7) modifying the hearing profile in response to the feedback provided. An audio playback device for playing back customized audio products based on the hearing profiles, and a hearing test device for use in the generation of hearing profiles are provided. The customized audio data product can be delivered using a network, or provided on an article of manufacture that comprises a data storage medium that is configured for connection to and for disconnection from an audio playback device. In one embodiment, an audio playback device and a hearing test device for producing hearing profiles are combined in a single appliance including a headset and earphones.

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PRODUCING AND STORING HEARING PROFILES AND CUSTOMIZED AUDIO DATA BASED

5

BACKGROUND OF THE INVENTION

Field of the Invention

10 The present invention relates to the distribution, customization and playback of audio data products, like telephone signals, music batch files, and streaming audio data. In particular, the present invention provides for distribution and/or playback of audio data products customized according to a hearing profile of a customer, and for techniques for the production of hearing profiles for customers.

15 ### Description of Related Art

The hearing profiles of individuals vary in a number of ways. The ability to hear sounds varies with frequency among individuals across the normal audio frequency range. Also, the dynamic range varies among individuals so that levels of audio stimulus that are perceived as soft sounds and levels of audio stimulus that are perceived as loud sounds differ from person to 20 person. Standard hearing tests are designed to produce an audiogram that characterizes such factors as frequency, sensitivity, and dynamic range in the hearing profiles of individuals. There are also other factors that affect a hearing profile. For example, psycho-acoustic factors concerning the manner in which a person perceives combinations of normal sounds affect the ability to hear in manners that can vary from person to person. Also, environmental factors such 25 as the usual listening environment of a person (library, conference room, concert hall) and the equipment on which the sound is produced (loud speaker, ear phones, telephone hand set), are important. In persons wearing hearing aids or using other assistive hearing devices, the type of aid or device affects the hearing profile. The physiology of an impairment suffered by the individual may also be an important factor in the hearing profile.

30 Audio products that are distributed to customers in digital or analog electronic form are intended for persons having hearing profiles within a normal range. For example, a popular

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compression technique for musical compositions being distributed across the Internet, known as MP3, is based on the psycho-acoustic model of a typical listener. Thus, some persons have hearing profiles that may interfere with enjoyment of MP3 compressed music. Other persons may have hearing profiles which make it difficult to understand normal telephone conversations using audio data from the telephone network. Also, individuals may have hearing profiles which make it impossible to enjoy a musical composition in the way which it was intended by the composer or musician, even if it were played back with very high fidelity. Other audio data products, such as streaming audio over the Internet, telephone calls over land line or wireless networks, audio accompanying television programs, radio broadcasts, live radio format broadcasts over the Internet, prerecorded audio books and the like, may be difficult for persons having some hearing profiles to fully enjoy.

The hearing profiles of individuals have been applied in the hearing aid field for customizing and fitting hearing aids for individuals. See, for example, U.S. Patent No. 4,731,850 entitled PROGRAMMABLE DIGITAL HEARING AID SYSTEM, invented by Levitt et al.; and U.S. Patent No. 5,848,171 entitled HEARING AID DEVICE INCORPORATING SIGNAL PROCESSING TECHNIQUES, invented by Stockham, Jr. et al. Thus, techniques for processing sound to offset variations in hearing are well known. However, these techniques are unavailable to persons not using hearing aids. Furthermore, many persons who could benefit from such processing are not in positions to use hearing aids, for a variety of reasons.

Accordingly, it is desirable to provide systems and methods to apply techniques for the processing of audio data according to hearing profiles for the benefit of individuals who are not wearing hearing assistance devices. Also it is desirable to provide tools to simplify the gathering of information needed to develop hearing profiles of individuals, and to apply the gathered information in the distribution and customization of audio data products.

SUMMARY OF THE INVENTION

The present invention provides customized audio data products, and systems and methods for producing the customized audio data products, for a customer, who may be an individual or a group of individuals, processed according to a hearing profile of the customer. Also, the present invention provides tools for gathering information concerning a customer's hearing profile, and for establishing and optimizing such profile for use in the production of the customized audio

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data products. According to the present invention, the quality of life as it relates to enjoying music, talking on the telephone, and participating in other listening activities can be improved for a wide range of individuals having hearing profiles that are not typical, whether or not the individual has been fitted with a hearing aid or other assistive hearing device.

In addition, the present invention provides an audio playback device for playing back customized audio products based on the hearing profiles, and a hearing test device for use in the generation of hearing profiles.

The customized audio data product can be delivered using a network, or provided on an article of manufacture that comprises a data storage medium that is configured for connection to and for disconnection from an audio playback device. In some embodiments, the customized audio data product is stored in the data storage medium. The data storage medium comprises in various aspects a CD-ROM, a DVD disk, a floppy disk, a solid state memory card, and other portable memory devices. In another embodiment, the data storage medium comprises a fixed memory element of an audio playback device, such as a personal computer with appropriate decoding and sound production resources.

In one preferred aspect of the invention, a hearing test device and an audio playback device comprise a single appliance such as a mobile phone, radio, wireless communication device, personal digital assistant with or without a wireless link, or music playback device, and may be coupled with or mounted on a headset. In one example, the appliance is a small portable unit comprising an audio processor, an audio transducer such as ear phones, an optional removable storage media port and a communication port packaged with a battery. The audio processor includes logic implemented using software, hardware or a combination of hardware and software supporting a hearing test, and supporting the decoding of customized audio data products. The removable storage media port is adapted to receive a solid state memory card or other removable memory device on which the customized audio data is stored. In various embodiments, both circuit components and earphones of the appliance are mounted in an ergonomic manner on a headset. In alternatives, circuit components of the appliance are packaged in a portable format and coupled to a headset using cables or wireless connections.

The communication port on the appliance in this aspect of the invention is adapted for connection to a data processor such as a personal computer that provides a user interface for support of the hearing test. The data processor can be coupled to the network across which

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access to sophisticated testing resources may be provided, or can comprise sufficient resources for conducting the test without access to remote resources.

Logic on the appliance comprises resources for the generation of the sounds used in the test in response to signals from the data processor. The data processor provides signals produced in response to user input provided during a testing, and signals produced in response to the testing algorithms being executed. User input generated during a testing is used for the production of a hearing profile for the customer. Customized audio products are produced using the hearing profile, and provided on a portable storage medium for connection to the removable storage media port on the appliance. The customized audio products may be played using the same appliance as used in the generation of the hearing profile. In addition, the hearing profile may be stored on the appliance itself, and used for the production of customized audio products in the appliance based on data products from a wide variety of sources.

Also, the customized audio products may be played on other devices, and stored in other formats as suits the particular needs the customer. Likewise the hearing profiles may be used, optimized and distributed in a variety of ways.

In one preferred aspect of the invention, a method executed by a system for providing customized audio data products includes the steps of (1) storing a machine readable hearing profile of a customer, (2) accepting via an input device or data network for example, machine readable orders from the customer for a particular audio data product, (3) associating the hearing profile of the customer with the particular audio data product, (4) modifying the particular audio data product according to the hearing profile to produce a customized audio data product, (5) delivering the customized audio data product to the customer, for example via a network or by a machine readable storage medium, (6) accepting feedback from the customer concerning the objective or subjective performance of the customized audio data product, and (7) modifying the hearing profile in response to the feedback.

In one embodiment of the present invention, the hearing profile and the audio data product are delivered to the customer via separate channels. In one example, the hearing profile is sent via one communication channel to a machine, such as a set top box, at the location in which the audio data product is played, and the audio data product is sent via another communication channel. According to this example, the hearing profile may be provided over the Internet, while the audio data product is provided via a television cable network. In another

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embodiment, the hearing profile is stored in a portable data storage device, such as a card having a magnetic strip memory, or a card having a non-volatile integrated circuit memory. The hearing profile of the customer in this embodiment is stored on a machine using a portable data storage device. The audio data product is customized by the machine using the hearing profile prior to playback.

The system in various embodiments provides input tools, such as a graphical user interface usable, for example, at a kiosk or accessible via a network, for accepting input data concerning a hearing profile of a customer, either supported by a specialized hearing test device as described above or by other resources for use in the test. The input tools are used for creating a machine readable hearing profile, which is stored in a registry of hearing profiles for use in the production of customized audio data products. Alternatively, the hearing profile is stored on a portable data storage medium for use by the customer, as described above.

Also, in various embodiments of the invention, the system provides tools for accepting input data characterizing the feedback from the customer. Processing resources are provided for modifying the machine readable hearing profile in response to the feedback data. The modifying of the machine readable hearing profile in one aspect of the invention comprises applying an optimization modeling process to the hearing profile, by which the profiles are improved over time using feedback arising from a variety of customized audio data products and from a variety of listening conditions.

According to other aspects of the invention, the system includes resources for determining a type of delivery for the customized audio data product, such as by prompting a customer to select a delivery mode. The step of modifying the particular audio data product is responsive to the type of delivery requested by the customer. Thus, for example, if a customer requests a music batch file to be delivered using the MP3 compression technique, the processing algorithm applied, or the parameters applied in a single algorithm, may be different than that applied if the customer requests a telephone conversation delivered via a telephone network customized according to the customer's hearing profile.

The present invention also provides a system that includes a source of an encoded audio data product, and processing resources that are configured to receive a request for the encoded audio data product, and to associate the encoded audio data product with a customer hearing profile. The customer hearing profile is used for production of a customized audio data product.

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The customer hearing profile comprises in various embodiments, the coefficients of the transfer function used to transform an audio data product according to a hearing characteristic of a customer, and an identifier of a transfer function used to transform the encoded audio data product, an identifier of a transfer function and coefficients for the identified transfer function, values indicating listening conditions in which the customized audio data product is to be played, specification of psycho-acoustic characteristics of a customer, an audiogram characterizing physical hearing characteristics of a customer, and executable software defining a transfer function for producing the customized audio data product. Thus it can be seen that the hearing profile used for production of the customized audio data product according to the present invention assumes a structure adapted to the distribution of processing and communication resources in the particular system being utilized.

The data processing resources are adapted according to the network resources available. Thus, the processing power for transforming the selected audio data product into the customized audio data product can be positioned at a central location accessible via a network, it can be distributed at a variety of locations in the network, it can be positioned in the playback device at a customer's home or office, and it can be implemented using combinations of processors located in several sites.

The architecture of the system can assume a variety configurations. In one aspect, the processing resources in the system include a network interface and logic to accept via the network interface data concerning the customer for use in producing the customer's hearing profile. In other embodiments, the system includes a source of a plurality of customer hearing profiles, such as a customer registry. In response to a request for particular audio data product, the hearing profile is retrieved from the registry and used for production of the customized audio data product.

A variety of user interface tools, such as Web pages, other tools accessible via a network, graphical user interfaces executed on a customer terminal, graphical user interfaces executed at a terminal in a kiosk, personal digital assistant (PDA) devices with network interfaces, and telephones, are included in various embodiments of the invention for accepting data concerning hearing profiles, selections of audio data products, selections of delivery modes, and other input data utilized in the system.

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The resources used for associating a customer hearing profile with an audio data product are centrally located at a site accessible via a network by a large customer base. However, in various embodiments, these resources can be distributed among a variety of sites accessible via a network. In a similar manner, the database for storing the hearing profiles of customers is coupled with the site used for associating the hearing profile with encoded audio data product. Alternatively, the database is distributed among a variety of locations for the purposes, for example, of load balancing, security and redundancy.

The customized audio data product is likewise implemented according to the particular configuration of the network processing and communication resources. Thus, the customized audio data product in various embodiments consists of the hearing profile, or portions of the hearing profile, concatenated with the selected audio data product for processing, or further processing, after delivery. In other embodiments, the customized audio data product includes the encoded audio data product transformed using the hearing profile, and ready for play back, prior to delivery. The transformed audio data is coupled to identifiers such as addresses or customer codes in various embodiments, which may be used in decoding the transformed data.

The encoded audio data product, which is customized and delivered according to the present invention comprises in various embodiments analog or digital instances of pre-recorded audio tracks, pre-recorded audio music tracks, live audio music streams, pre-recorded audio voice tracks, live audio voice tracks, live audio telephone data, audio tracks associated with television programs or movies, or other kinds of batch or streaming mode audio data.

The present invention also supports a variety of modes of delivery for the customized audio data product. The customized audio data product is delivered in various embodiments by providing resources to store the customized audio data product on machine readable storage media, such as CD ROM, DVD, or other storage media formats suitable for shipping to the customer. In one preferred embodiment, the customized audio data product is transmitted via a network to the customer using a format such as MP3, formats for voice over the Internet VoIP, or standard telephone formats. The network in various embodiments includes the Internet, a private network, a telephone network, a satellite communications network, or other wired or wireless communication technologies. The transmitted customized audio data product is adapted for a particular playback device in one embodiment. Thus, the product is adapted for transmission to a

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personal computer, to a hand-held PDA having a wireless communication link, or directly to a playback device with a wired or wireless network interface.

Thus, the present invention provides a comprehensive system and method for providing audio data products customized according to individual hearing profiles of customers. The system and method operate without requiring assistance of specialized listening devices or hearing aids and allow for optimization of the hearing profiles and customizing processes according to characteristics of the customer, to the particular audio data product being customized, and the listening environment in which the product is to be enjoyed. Utilizing the techniques of present invention, greater numbers of people may take advantage of the processing techniques developed in the hearing aid arts to account for variations in hearing profiles of individuals. Further, the need for hearing aids or other assistive listening devices will be reduced, and many people will be able to the avoid the need for such devices completely.

Other aspects and advantages of the present invention can be seen on review of the drawings, the detailed description, and the claims which follow.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 is a diagram of one example system for delivering customized audio data products according to the present invention.

Fig. 2 illustrates a method for delivering customized audio data products according to the present invention.

Fig. 3 is a heuristic diagram illustrating a variety of system configurations and implementations of the present invention.

Fig. 4 is a diagram of one example of a customized audio data product according to the present invention.

Fig. 5 is a diagram of another example of a customized audio data product according to the present invention.

Fig. 6 is a diagram of one example of a hearing profile for use in producing customized audio data products.

Fig. 7 is a diagram of another example of a hearing profile for use in producing customized audio data products.

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Fig. 8 is a diagram of yet another example of a hearing profile for use in producing customized audio data products.

Fig. 9 is a simplified diagram of a user interface for selecting a particular audio product in conjunction with the system of the present invention.

Fig. 10 is a simplified diagram of a user interface for setting up a hearing profile for a customer in conjunction with the system of the present invention.

Fig. 11 is a simplified diagram of the user interface for obtaining feedback from a customer concerning a hearing profile in conjunction with the present invention.

Fig. 12 illustrates environments in which input data is received from customers in conjunction with the production and optimization of hearing profiles according to the present invention.

Fig. 13 illustrates optimization loops, and the interaction among optimization loops for producing hearing profiles according to the present invention.

Fig. 14 illustrates processing resources for dynamic optimization of hearing profiles according to the present invention utilizing reference model adaptive control techniques.

Fig. 15 illustrates a graphical user input tool for the purposes of gathering information concerning a hearing profile of a customer.

Fig. 16 illustrates another graphical user input tool for gathering information concerning hearing profiles of customers.

Fig. 17 illustrates a second level graphical user input tool used in the conjunction with the input tool of Fig.16.

Fig. 18 illustrates another second level graphical user input tool used in the conjunction with the input tool of Fig.16.

Fig. 19 illustrates a configuration of an alternative system according to the present invention in which the hearing profile is applied in a set top box, and delivered via a communication channel different than that used for the audio data product.

Fig. 20 illustrates a configuration of an alternative system according to the present invention in which the hearing profile is provided using a portable storage device for use by a customer to produce customized audio data.

Fig. 21 illustrates a configuration of an alternative system according to the present invention in which the customized audio data is provided on a portable storage device.

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Fig. 22 illustrates a combination hearing test and playback device for customized audio data according to the present invention.

Fig. 23 illustrates an alternative implementation of a combination hearing test and playback device for customized audio data according to the present invention.

Fig. 24 is a block diagram of a hearing test and playback appliance for use with the device of Figs. 22 and 23.

DETAILED DESCRIPTION

A detailed description of the various embodiments of the present invention is provided with reference to Figs. 1 through 24.

Fig. 1 provides an illustration of one example system for delivering customized audio data products. Other examples will be discussed below. The system includes a server 10 which is coupled to a network or networks 11 for communication with other network connected devices. The server 10 is also coupled to a database 12 storing hearing profiles of customers. In this example, a customer has a personal computer 13 which is coupled to the network or networks 11. The personal computer 13 includes data processing resources, such as memory, a graphical user interface program, and a digital signal processing based sound board coupled with ear phones 14 for playing back an audio product stored in the PC or being received by via the network through the PC. The network or networks 11 interconnect services to supply audio data products. In this example, suppliers of streaming audio are represented by the line 16, suppliers of MP3 batch files are represented by the line 18, and suppliers of digital and analog music library files are represented by the line 20.

In this example, the server 10 includes a variety of data processing resources, including a network interface or interfaces, a host processor for managing an Internet based service, memory resources, and a processor, such as a digital signal processor, used in the customizing of audio data products, and used for optimizing hearing profiles stored in the database 12. In this example, the network interface or interfaces of the server 10 act as a source of audio data products. The user issues an order ORDER via the network as represented by line 22, for a particular audio data product. Resources in the server 10 translate the order into a form

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ORDER', as represented by line 24, for retrieving the audio data product from the network. The particular audio data product requested by the customer is returned via the network as represented by line 26 to the server 10. Data processing resources in the server 10 associate a hearing profile from the hearing profile database 12 with the particular audio data product. The customized audio data product is then returned as represented by line 28 via the network to the customer PC 13. The PC 13 processes the customized audio data product and supplies it for customized audio playback at the ear phones 14.

The system of Fig. 1 also provides data processing resources for gathering information needed for developing and storing hearing profiles in the database 12. In addition, the system includes resources for obtaining feedback from customers used in the optimizing of hearing profiles.

Fig. 2 illustrates a basic method of operation of a system according to the present invention. Although Fig. 2 is drawn in the form of a flow chart, the particular sequence of steps can be modified as suits particular implementation or context of execution.

A first step in the method is to characterize the hearing of a customer (block 50). The hearing of a customer can be characterized in the system of the present invention indirectly, such as by entering an audiogram, entering the make of the hearing aid and associated prescription, if any is used by the customer, or entering responses to questionnaires. This indirect input data is processed by the system to produce a hearing profile which can be used in a production of customized audio data products. Alternatively, the hearing of a customer may be characterized directly. For example, a customer may sample a closed set of hearing profile choices and select a preferred one. Alternatively, a network based test can be executed by which information needed for administering the test is delivered to the customer via the Internet or other network, and the customer's responses to stimulus in the test are returned via the network to the processing resources in the system. In another example, a kiosk is set up in a public location for use by customers to establish a hearing profile using the processing resources of the kiosk designed for administering the hearing tests. In yet another embodiment, a test is administered over the telephone, particularly when the audio data product to be delivered is telephone calls. These direct measurements of the hearing profile of customer are processed by the system into hearing profiles used for customizing audio data.

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Another process in the method of the present invention is to determine the listening conditions in which the customer will be using the customized audio data product (block 51). The listening conditions may include free field environments in which the transducers consist of loud speakers in a living room being driven by a television, radio, or a home stereo, speakers in an automobile driven by the automobile sound system, or concert conditions of some sort. Other listening conditions may be monaural, such as a telephone or an existing prosthetic device. In another example, listening conditions consist of binaural settings, in which sounds are to be delivered via a headset or a binaural prosthetic device. The listening conditions can be characterized in the hearing profile to be applied for producing the customized audio data product.

The next process illustrated in Fig. 2 in the method of the present invention involves determining the mode of delivery of the audio data product which the customer has requested (block 52). After it has been customized, the audio data product can be delivered on a storage medium, or via a network. Also, the format of delivery, such as an MP3 batch file to be played after it has been delivered and stored on the customer's machine, or a streaming audio product which can be listened to while it is being downloaded from the Internet from a live source or from a stored library of audio products, may be subject to different customization algorithms.

The system also includes resources for determining the audio product requested by the customer (block 53). These resources may be implemented using well-known Internet server techniques for commercial transactions and for presenting catalogs of goods or services. Examples of audio products which may be requested include pre-recorded music, live music performances, radio broadcasts, radio format streaming audio products, telephone calls, television shows, audio books and any other audio data source.

Based upon one or more of the processes in blocks 50-53, the system determines the processing needed to customize the audio data product (block 54). The information gathered in the processes of blocks 50-53 is applied using the principles developed for customizing and fitting hearing aids, and improved using adaptive optimization processes as discussed below.

The processing is applied, and the customized audio data is provided to the customer according to the mode of delivery requested (block 55). The customized audio data may take on a variety of formats as discussed in more detail below.

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Another process provided by the system is to obtain customer feedback concerning the objective and subjective performance of the customized audio data (block 56). The feedback is retrieved using Internet based techniques for gathering data in one embodiment. Alternatively, customers can be called on the telephone or prompted to fill out questionnaires to rate the performance of the products.

Utilizing the feedback obtained, the hearing profiles are adjusted (block 57). Adjustments may be made either on the fly, or offline as is determined by the processing resources available, and the type of product being delivered. For example, for streaming audio products it may be desirable to optimize the customization of the product on the fly so that the customer can experience the improvements resulting from feedback being returned to the system within a short period of time.

The final process illustrated in the method of Fig. 2 is to update the database used for storing hearing profiles based upon the adjustments made in response to customer feedback (block 58). In this manner, a database is developed of hearing profiles, including the adjustments made to hearing profiles based on specific kinds of feedback for specific kinds of audio data products. Using information in the database, the system is able to improve techniques for establishing and adjusting hearing profiles over time according to adaptive optimization techniques. In addition, the database may be used to as a resource for delivering other products to the customer.

Fig. 3 is a diagram used for illustrating a variety of configurations of the system of the present invention. It will be apparent to persons of skill in the art that a large number of variations in architecture for a network based data processing system can be applied, depending on such issues as load balancing, security, reliability, and speed.

Fig. 3 illustrates a system that includes a network server 100 which is coupled to a network or networks 101. A plurality of customer end stations, including customer end station 102, customer end station 103, customer end station 104, and customer end station 105 are coupled to the network 101. Also, the network interconnects suppliers of audio data products, such as audio data product server 106. The network server 100 also includes a separate link 107 to another supplier of audio data products 108. Also, connected to the server 100 via a link 109 is a registry of customer hearing profiles 110, such as a database which stores hearing profiles accessible using customer identifiers. In this example, a transform engine 111 is coupled to the

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network server 100 via link 112, and also to the network 101. The transform engine 111 includes the resources for applying hearing profiles to an audio data product, in order to produce the customized audio data products for delivery to the customer. The configuration of Fig. 3 also includes other transform engines distributed in the system. Thus, the server 106 for delivering audio data products includes a transform engine 113. Also, the customer end station 105 consists of a personal computer including a transform engine 114 based on, for example, a digital signal processing card.

The customer end stations 102-105 illustrate a variety of playback modes which may be served by the system of the present invention. Thus, the customer end station 102 consists of an MP3 player, which transduces batch mode MP3 music files for supply to ear phones 115. The customer end station 103 consists of a personal computer which is coupled to a stereo receiver 116 which drives loud speakers 117. Customer end station 104 consists of a telephone which supplies the customized audio data to a telephone handset 118. Customer end station 105 consists of personal computers with an on-board transform engine which supplies the audio data transformed to match the hearing profile of the customer to ear phones 119.

The network 101 is illustrated in Fig. 3 as a single entity. However, the network may comprise a plurality of networks, including the telephone network, the World Wide Web, private networks, land based wireless networks, satellite communication networks, and other forms of data communication. The plurality of networks by which audio data products may be communicated can be used alone, or in combination as suits the particular communication channel being set up to deliver the product.

In one preferred mode, the particular audio data product selected by the customer has a particular format, such as an MP3 format. The customized audio data product is also delivered in the particular format of the original audio data product. In this manner, the customer is able to playback the customized audio data product using the type of equipment for which the original product was developed. In alternative embodiments, the customized audio data product is transformed from the format of the original audio data product into the format of the listing device in which customer intends to play back the customized audio data product.

The server 100 in one preferred embodiment includes resources for keeping information used for billing the customer for ordered customized audio data products.

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Figs. 4 and 5 illustrate alternative formats for the customized audio data product according to the present invention. In Fig. 4, the customized audio data product consists of a header 200 that includes, for example, a destination address, a field 201 holding the hearing profile, or portions of the hearing profile, and a field 202 holding the audio data product which has been retrieved and modified by the addition of the header 200 and hearing profile 201. The format of customized audio data product shown in Fig. 4 is utilized when the transform engine is located at the customer site or remote from the server at which the hearing profile is associated with the audio data product to be delivered.

Fig. 5 illustrates an alternative format for a customized audio data product which includes a header 210, including a destination address or other parameter like a digital signature or user identification number identifying the customer or associating the customized data product with the customer, and a field 211 holding a transformed version of the audio data product. The format of customized audio data product shown in Fig. 5 is utilized when the transform engine is coupled with the network server which associates the hearing profile with the particular audio data product to be delivered. The parameter, such as the address, user identification number or digital signature mentioned above, is used in decoding the transformation of the audio data product in one embodiment.

According to the present invention, an article of manufacture comprises the customized audio data product having a format such as those shown in Figs. 4 and 5, stored on a storage device, such as machine readable, portable non-volatile memory device.

Figs. 6, 7 and 8 illustrate alternative formats for the hearing profiles to be stored in the registry 110. The hearing profile shown in Fig. 6 includes a customer ID 250, coefficients of transform equations 251, and an identifier of the playback device type and listening environment 252 in which the audio data product is to be played. In Fig. 7, the hearing profile includes a customer identifier 260, the audiogram for customer 261, listening condition data 262, and psycho-acoustic parameters 263 which relate to the listening characteristics of the customer. The hearing profile shown in Fig. 8 includes a customer identifier 270, and software 271 along with code data structures 272 that in combination provide executable transform code for producing the customized audio data product from the selected audio data product. The three examples of hearing profile formats shown in Figs. 6-8 are representative of a large number of hearing profile

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formats that could be utilized depending on the type of transform processes being executed, the type of audio products being delivered, and other factors related to the architecture of the system.

According to the present invention, an article of manufacture comprises the hearing profile having a format such as those shown in Figs. 6, 7 and 8, stored on a storage device, such as machine readable, portable non-volatile memory device.

As mentioned before, the system of the present invention provides user input tools for selecting audio products, for setting up hearing profiles, and for providing feedback about the performance of the customer's audio data products. Figs. 9 through 11 show simplified graphic user interface pages used for prompting a user to input data for these purposes. Thus, Fig. 9 shows a page 300 prompting the user to select an audio product. The page 300 includes a first graphical tool 301 for selecting an MP3 music file; a second graphical tool 302 used for selecting streaming audio such as a radio format data, and a third tool 303 used for selecting live audio products, such as a web broadcast performance, or telephone call. Fig. 10 shows a simplified user interface page 310 for setting up a hearing profile. In this example, the page 310 includes a tool 311 for entering audiological data, such an audiogram. The tool 312 is provided for allowing a user to enter playback device types. The tool 313 is included on the page 310, prompting the user to enter environmental parameters. Fig. 11 shows a simplified user interface page 320 prompting the user to provide feedback concerning the hearing profile. Thus in this example, the tool 321 is provided prompting the user to enter subjective performance data, such as whether the customized audio data products sounded good or bad, or whether the pitch of the product was too high or too low. Also, tool 322 is provided to allow the user update the playback device types being used. Finally, in the example of Fig. 11, the tool 323 is provided by which the user is prompted to update parameters about the environment. The pages shown in Figs. 9-11 are obviously simplified versions showing a range of possibilities for input tools provided by the system of the present invention.

Fig. 12 illustrates a variety of scenarios by which a central server 400 interacts with customers in the development and optimization of hearing profiles, and for the selection and delivery of customized audio data products. Thus, the system in Fig. 12 consists of the server 400 which is coupled to the database 401 storing hearing profiles. The server 400 is coupled to the Internet 402, and via Internet 402 to a kiosk 403, and to a plurality of other locations, including a personal computer 403 at the home of the customer, and via wireless link 405 to a

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personal digital assistant 406, by which the customer provides feedback away from home. The kiosk 403 includes a computer 410 having a graphical user interface such as a touch screen 411 for administering a hearing test to gather data for development of hearing profiles. In the preferred embodiment, sounds used in the test are provided using an acoustic dome 411, such as the stereo sound dome unit known as a Virtual Audio Imager provided by Brown Innovations, Inc. of Chicago, IL. Utilizing the acoustic dome 411, carefully controlled audio vectors are generated and directed to the customer for use in direct measurement of the customer's hearing profile. A sequence of graphic user interface screens are presented on the touch screen 412, in combination with the audio stimulus provided by the acoustic dome 411. The user's hearing profile is developed based on interaction via the touch screen 412.

The personal computer 404 at the customer's home is utilized for follow-up interaction with the customer, or for gathering indirect data concerning the hearing profile of customer. Thus, via the Internet 402, the server 400 can deliver questionnaires and simple audio tests to the home PC 404. Also, a user can access a web page, or use electronic mail, to provide feedback concerning the performance of the customized audio data product that had been played by the user. Finally as shown in Fig. 12, the user may access the server 400 using a wireless personal digital assistant 406 to provide feedback concerning the performance of the customized audio data product.

Fig. 13 illustrates optimization loops used for the production of a customer's hearing profile according to the present invention. The first optimization loop A is based on administration of an interative test. For each customer, the vector "s" representing a sound environment, a vector "f" representing a fitting parameter, and a vector "e" representing the customer's evaluation at this stage of the test is developed. The sequence of stimuli is applied to produce the vectors. The vectors are applied to a second loop C. In the second loop C, a fitting algorithm is executed based upon the aggregate of data from many patients. In this loop, data mining techniques can be used to make a best initial guess of the fitting to be applied to customer. The fitting being developed for the customer is applied to a feedback loop B. In the feedback loop B, the fitting "f" developed during the test for the profile represented by transform g^t is applied to a real world environment g^r. The evaluation "e" provided by the customer in response to the real world experience is used in feedback for the purposes of optimization of the fitting.

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Fig. 14 illustrates processing resources used in the adaptive optimization of a hearing profile according to the present mention. The customer's profile "p" is applied to a fitting processor 500. Other inputs to the fitting processor 500 include prior evaluation data provided on line 501, prior sound environment data delivered online 502, and customer input. A particular fitting vector "f" is provide on line 503. This fitting vector is processed according to a transfer function 504. Customer evaluation of the playback is provided on line 501. The fitting vector on line 503 and the evaluation on line 501 are fed to a performance correlation unit 505. The performance correlation unit 505 generates a result that is applied to data mining resources 506 for the purposes of determining a reaction to the correlation result. Data mining produces parameters used in testing optimization unit 507. A testing optimization unit 507 updates the environmental parameters for the customer. The data mining resources 506 are seeded with the information gathered from prior evaluations for given customers. Thus, model reference adaptive learning using data mining techniques can be utilized to optimize the fitting for a particular customer. For additional information concerning model reference adaptive optimization techniques, reference can be made to LANDAU, *ADAPTIVE CONTROL, THE MODEL REFERENCE APPROACH*, Merkel Dekker, Inc., New York, 1979.

Figs. 15-18 illustrate graphical user interface tools for use in a kiosk environment such as the kiosk 403 shown in Fig. 12, for development of a hearing profile using direct measurements. The user interface of Fig. 15 provides a simple interface for gathering information about the profile the user. The tool includes a first indicator 600 for signaling to a user whether the left or right ear is being stimulated. Next, a label using either text or graphics is displayed for indicating to the user that a test for loudness is being made. Next, a label 602 for bass and treble tests is provided. A label 603 for testing clarity is provided. A label 604 is provided identifying tests for noise and distortion. The user is given the option of making three selections for each test represented by a left facing arrow 605, a center button 606, and a right facing arrow 607. Thus, for example during a loudness test for the left ear, an indicator in region 600 identifies stimulus to the left ear. A sound is played using the acoustic dome 411 shown in Fig. 12. The user selects the left arrow if the tone is too loud, the right arrow if the tone is too soft, and the center button 606 if the tone sounds right. Similar stimulus-response tests are administered for the other factors to be determined. The upper left-hand section of the screen includes a button 608 to signal to repeat of the test, and a button 609 to signal that the user is ready to proceed to a

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next test. Using this stimulus-response technique, with limited feedback options, a basic hearing profile can be developed without professional assistance.

Figs. 16-18 illustrate another technique for gathering feedback from a customer during the development of a hearing profile. A first screen as shown in Fig. 16 is displayed with a row of condition indicators 700-702 across of the top of the screen. The indicators show whether the test being executed is adapted to determine soft sounds, normal sounds, or loud sounds. An array of 16 buttons arranged in a 4 by 4 matrix in this example is displayed to the user. A set of sound stimulus is played, and the user is instructed to select a corresponding button in the 16 button array. After a first selection, preferably within the interior four buttons in the region 703 of the array, a second screen, such as the screen shown in Fig. 17 is displayed to the customer, linked to the choice made in the first screen. The second screen of Fig. 17 includes a second array of 16 buttons presented to the user. The user again selects a preferred setting for a loudness over balance of the stimulus to further refine the profile data. Fig. 18 illustrates another second level screen for the purposes of selecting the preferred level of clarity over noise and distortion for the signal. Utilizing these graphical interface tools in combination with audio stimulus, relatively sophisticated information concerning users' hearing profiles can be gathered automatically by an Internet based, or kiosk based, testing system.

Fig. 19 illustrates another system configuration for the delivery of customized audio data products according to the present invention. The system includes a customized audio server 900 which is coupled to a network or networks 901 for communication with other network connected devices. The servers are also coupled to a hearing profile database 902, such as described above. In this example, a customer has a display system 903 which may be a computer monitor, a television, or another device that is coupled to the network or networks 901. The display system 903 is coupled to an audio system for providing playback of the customized audio, in this example using headphones 904. Also coupled to the display system is a set top box 905 by which the display system is coupled to the network or networks 901. The set top box 905 combines the hearing profile data and the program including audio data to produce the customized audio data product at the customer site.

In one example, the set top box is coupled to a cable television network 906 across which movies and television programming that include audio data products are supplied to the display system 903. Thus, one source of audio data products coupled to the network or networks 901 is

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cable television network 906. Other sources of audio data products coupled to the network or networks 901 include streaming audio data 907, MP3 encoded audio data 908, and a digital/analog music library 909.

The customized audio server 900 acts as a gateway for managing the delivery of customized audio data products. In this example, the customized audio server 900 is also coupled to the telephone network, as indicated by the telephone 910. One example transaction using the system of Fig. 19 includes placement of an order for customized audio data products using the telephone 910 using touch tone commands or voice recognition mechanisms. When the order is placed to the customized audio server 900, a request is issued to the source of the requested audio data product, in this example to the cable television network, for delivery of a chosen audio data product. Also, the customized audio server 900 transmits a hearing profile to the set top box 905 across a communication channel between the customized audio server 900 and the set top box 905. The cable television network 906 transmits the requested programming including the audio data product to the set top box 905 using a separate communication channel. Thus, for example, the hearing profile is transmitted from the customized audio server 900 to the set top box 905 using the Internet, while the programming is supplied from the cable television network 906 using the television cable protocols and media. Also, separate Internet channels may be used for the independent channels from the customized audio server 900 and from the source of the audio data.

In other transactions using the system of Fig. 19, the order may be placed via the communication link between the set-top box 905 and customized audio server 900, or via other communication links with the customized audio server 900. Also, feedback concerning the performance of the customized audio data product can be provided using the set top box 905 or via other communication channels to the customized audio server 900. In other configurations, the database 902 is coupled to the network or networks 901 at a site apart from the customized audio server 900.

Fig. 20 illustrates another system configuration for producing customized audio data products according to the present invention in which the hearing profile is carried on a portable storage device 950, such as a plastic card having a magnetic strip or carrying an integrated circuit memory. In this example, a hearing profile database 951 is coupled to the network or networks 952. A plurality of sources of audio data products are also coupled to the network or networks

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952, including, for example, streaming audio data 953, MP3 encoded audio data 954, cable television network 955, and a digital/analog music library 956. In the system shown in Fig. 20, a kiosk workstation 960 is coupled to the network or networks 952. Using the workstation 960 and the tools described above for the creation of a hearing profile, an individual generates a hearing profile data set. A card writer 961, or other resource for storing data on a portable storage device 950 is coupled to the kiosk workstation 960. The hearing profile data is stored on the portable storage device 950 and the individual carries it to a location at which a playback device 963 is used to play the customized audio. The user has a personal computer 964, or other network connected appliance such as an internet enabled cell phone or palm sized computer, which is coupled to the network or networks 952. Coupled with personal computer 964 is a card reader 965 by which the data in the portable storage device 950 is downloaded to the personal computer 964.

A transaction using the system of Fig. 20 includes a user issuing an order for a particular customized audio data product directly to the source of the product. Thus, in this example, the order for a customized audio data product is placed directly to the digital/analog music library 956. The selected audio data product is delivered to the personal computer 964. The personal computer 964 uses the hearing profile from the portable storage device 950 to produce the customized audio data product, and delivers it to the playback device 963. In one embodiment, the personal computer 964 is also configured to provide feedback information concerning the performance of the customized audio data product. The feedback information is delivered via the network or networks 952 to the hearing profile database server 951.

Portable storage devices carrying hearing profile data may be used in a variety of settings. For example, a card reader may be coupled to a set top box for a cable or satellite television network to allow for the delivery of customized audio data with standard programming. Also, a card reader and headphone set may be installed in a movie theater to allow for the delivery of customized audio data to moviegoers. Card readers may be coupled to telephones to allow for the correction of audio telephone conversations. Examples of portable storage devices include plastic cards with magnetic strips, PC Card format or PCMCIA format add-on cards for computers, flash memory cards, cards like the "Memory Stick" provided by Sony Corporation, a floppy disk, or other machine readable storage devices adapted to be carried from machine to machine.

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Also, in various embodiments of the present invention, customer identification data, such as fingerprints or other biometric data, may be recorded and stored with the hearing profile and/or the customized audio data of a customer for purposes of authentication of feedback data, automatic accounting for use of the hearing profile data, or access playback authorization and other purposes.

Fig. 21 illustrates yet another configuration for distribution of customized audio data products according to the present invention. In Fig. 21, the customized audio data product is provided on a portable storage device 1000. The article of manufacture consisting of the portable storage device having a customized audio data product stored therein is produced in a server 1001 coupled to a network or networks 1002. A plurality of sources of audio data products, for example as mentioned before including a source of streaming audio 1003, a source of MP3 audio 1004, a cable television network 1005, and a digital/analog music library 1006, are coupled to the network or networks 1002.

In one example scenario among many possible scenarios, a customer logs on at end station 1007 coupled to the network or networks 1002. A customer places an order by a message ORDER 1008 to server 1001. The server 1001 produces the article by ordering the requested audio data product from a particular source, such as by a message ORDER' 1009 sent to the digital/analog music library 1006. The audio data product PRODUCT 1019 is returned to the server 1001. The server combines a hearing profile for the customer from the hearing profile database 1018 with the PRODUCT 1019 to produce a customized audio data product as described above. The hearing profile is provided by the user in other embodiments via the network or using a portable storage device. The server includes a card writer 1010, or other resources for storing data on a portable storage device. The server uses the card writer 1010 to write the customized data product onto the portable storage device 1000.

The portable storage device 1000 is delivered to the customer, by mail or by hand delivery, or otherwise. A customer uses a playback device 1011 having a card reader 1012, or other port for a removable storage media. For example, the playback device 1011 may be a hand-held audio device like a "Walkman" style device with an interface for "Memory Stick" portable storage technology provided by Sony Corp. or other similar portable playback devices. Other portable storage media include magnetic tape, CDROM format disks, DVD format disks, magnetic disks, and a variety of media adapted for particular environments.

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Fig. 22 is a schematic diagram of a hearing test and playback device according to the present invention, used for the production of hearing profiles, and for playing back customized audio data products. The device includes a headset 1100 having ear phones 1101 and 1102. The headset is coupled by a communication medium such as cable 1103, to a handheld appliance 1104. The appliance includes a port for a removable storage device 1105, and a port for a communication medium 1106. The communication medium 1106 is coupled to a computer 1107 which is coupled to a data network medium 1108. The computer 1107 includes a user interface supporting the hearing test, such as described above with respect to Figs. 9-11 and 15-18. The computer is in turn coupled to the data network medium 1108, for access to hearing test resources located remotely in the network. The computer 1107 acts as an intermediate station supporting the hearing test. In an alternative embodiment, the computer 1107 includes the resources locally sufficient to execute the test without relying on access to other resources via the network medium 1108. The appliance 1104 includes resources for playing sounds as directed by signals from the computer produced in response to the user input, and in response to the algorithms of the test. The appliance is designed so that the sounds produced on the ear phones during the test are calibrated to support accurate test results. In this embodiment, the appliance 1104 is a small device adapted to be handheld, or to be conveniently carried in a pocket or handbag, for example.

Fig. 23 illustrates an alternative embodiment of the portable test/playback appliance. In Fig. 23, the circuit components of the device in appliance 1104 are mounted on the headset 1120 along with the ear phones. Of course, Fig. 23 is a simplified diagram. In a preferred embodiment, the circuit components in the appliance 1104 are mounted using an ergonomic design within the structure the headset. In this embodiment, the appliance 1104 includes the port for portable storage device 1105, and the port 1106 for a communication media used for connection to a computer, or via a network like the internet, the wire line telephone network, the wireless pager network or mobile phone network to a remote system. The port 1106 may be a wireless connection or a cable connection as suits particular implementation.

Fig. 24 is a simplified block diagram of the circuit components of the test/playback appliance 1104. The appliance may be a mobile phone, a music play back device, a radio, a wireless appliance, a combination product or other audio product. The appliance 1104 includes an audio processor 1125. The audio processor is coupled to a removable storage media port

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1126 and a communication port 1127. The battery 1128 powers the components of the appliance 1104, as well as the ear phones on the accompanying headset. The audio processor 1125 includes logic, such as software stored in a non-volatile memory 1129 for supporting the hearing test, and for supporting the decoding of customized audio data products stored in a solid state memory card 1130 or other portable storage device coupled to the port 1126. If this example, the nonvolatile memory 1129 includes a set of test sounds which are adapted for the particular ear phones used with the appliance, and test interface routines which support the communication between the appliance and the computer or other test processor on which a user interface is provided supporting the test. Also, the nonvolatile memory 1129 includes decoding resources that support the playback of the customized audio data product read from the solid state memory card 1130. The decoding resources may include logic that utilizes parameters associated with the customized audio data product for a decoding data so that only an appliance or user having these particular parameters can playback the product. In alternative embodiments, the decoding resources are adapted for industry standard audio data encoding techniques.

In alternative embodiments, the appliance 1104 includes user input devices, such as buttons or a touch screen supporting a graphical user interface in the style of a personal digital assistant (PDA), for the test process, and the communication media connects to the Internet or other networks for access to remote test processors used to generate the hearing profile.

In summary, the present invention provides a system and method for producing hearing profiles for customers to be used in the production of customized audio data products. The hearing profiles allow for the customized and optimized sound processing for each customer. The process can be optimized over time and over situations and for each modality for the delivery of the sound product. The customized audio data products are delivered via a variety of communication channels, to specific playback devices or to generic playback devices as suits a particular customer.

The system and method of the present invention provide for delivery of optimized audio products to persons that do not use hearing aids or other assistive hearing devices. Audio products from a variety of sound data sources can be customized using hearing profiles, and delivered to a customer on demand.

While the present invention is disclosed by reference to the preferred embodiments and examples detailed above, it is to be understood that these examples are intended in an illustrative

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rather than in a limiting sense. It is contemplated that modifications and combinations will readily occur to those skilled in the art, which modifications and combinations will be within the spirit of the invention and the scope of the appended claims.

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CLAIMS

What is claimed is:

1. A system for producing customized audio data, comprising:

a source of an audio data product;

processing resources, coupled to the source of an audio data product, configured to associate the audio data product with a customer hearing profile for use in production of a customized audio data product.

2. The system of claim 1, wherein the customer hearing profile comprises coefficients of a transfer function to transform the audio data product according a hearing characteristic of a customer.

3. The system of claim 1, wherein the customer hearing profile comprises an identifier of transfer function to transform the audio data product according a hearing characteristic of a customer.

4. The system of claim 1, wherein the customer hearing profile comprises an identifier of a transfer function and coefficients of the identified transfer function to transform the audio data product according a hearing characteristic of a customer.

5. The system of claim 1, including a machine readable registry of customer hearing profiles corresponding to registered customers of the audio data product in communication with data processing resources, and further including resources for reading, modifying and writing particular customer hearing profiles in the plurality.

6. The system of claim 1, wherein the customer hearing profile includes a value indicating listening conditions in which the customized audio data product is to be played.

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7. The system of claim 1, wherein the customer hearing profile includes a value indicating a hearing characteristic of a customer for whom the customized audio data product is to be played.

8. The system of claim 1, wherein the customer hearing profile includes a specification of psycho-acoustic characteristics of a customer for whom the customized audio data product is to be played.

9. The system of claim 1, wherein the customer hearing profile includes an audiogram characterizing a customer for whom the customized audio data product is to be played.

10. The system of claim 1, wherein the customer hearing profile includes software defining a transfer function for producing the customized audio data product.

11. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the data processing resources include logic to accept data concerning a customer for whom the customized audio data product is to be played, and to produce a customer hearing profile for the plurality of customer hearing profiles in response to the accepted data.

12. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the data processing resources include a network interface, and logic to accept, via the network interface, data concerning a customer for whom the customized audio data product is to be played, and to produce a customer hearing profile for the plurality of customer hearing profiles in response to the accepted data.

13. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the data processing resources include a network interface, and logic to accept, via the network interface, data concerning a customer for whom the customized audio data product is to be played, and to modify a customer hearing profile in the plurality of customer hearing profiles in response to the accepted data.

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14. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the data processing resources include a network interface, and an interface accessible to a user via the network interface to accept data concerning a customer for whom the customized audio data product is to be played, and to produce a customer hearing profile for the plurality of customer hearing profiles in response to the accepted data.

15. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the data processing resources include a network interface, and an interface accessible to a user via the network interface to accept data concerning a customer for whom the customized audio data product is to be played, and to modify a customer hearing profile in the plurality of customer hearing profiles in response to the accepted data.

16. The system of claim 1, wherein the processing resources include a network interface for connection to a data network, and the source of the audio data product comprises the network interface.

17. The system of claim 1, wherein the processing resources include a network interface for connection to a data network, and resources to receive the customer hearing profile via the network interface.

18. The system of claim 1, wherein the audio data product comprises pre-recorded audio tracks.

19. The system of claim 1, wherein the audio data product comprises pre-recorded audio music tracks.

20. The system of claim 1, wherein the audio data product comprises live audio music streams.

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21. The system of claim 1, wherein the audio data product comprises pre-recorded audio voice tracks.

22. The system of claim 1, wherein the audio data product comprises live audio voice streams.

23. The system of claim 1, wherein the audio data product comprises live audio telephone data.

24. The system of claim 1, wherein the processing resources include a network interface for connection to a data network, and user input comprises an interface accessible via the network interface.

25. The system of claim 1, wherein the user input comprises tools by which a user selects an instance of the encoded audio data product, and issues a request for the selected instance.

26. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the user input comprises tools by which a user adds a customer hearing profile to the plurality of customer hearing profiles.

27. The system of claim 1, including a source of a plurality of customer hearing profiles, and wherein the user input comprises tools by which a user modifies a particular customer hearing profile in the plurality of customer hearing profiles.

28. The system of claim 1, wherein the processing resources include logic to produce information about billing for requested audio data products for customers.

29. The system of claim 1, wherein the audio data product comprises a digitally encoded product.

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30. The system of claim 1, wherein the audio data product comprises an analog encoded product.

31. The system of claim 1, wherein the audio data product comprises data encoded according to a particular format suitable for playback by audio systems adapted for the particular format, and the customized audio data product comprises data encoded according to the particular format.

32. The system of claim 1, wherein the data processing resources include a processor which transforms the audio data product to the customized audio data product using the customer hearing profile, a network interface, and logic for transmitting the customized audio data product to a remote location via the network interface.

33. The system of claim 1, wherein the data processing resources include a network interface, and logic for transmitting the audio data product and at least a portion of the customer hearing profile to a remote location via the network interface.

34. The system of claim 1, wherein the data processing resources include a network interface, and logic for transmitting at least a portion of the customer hearing profile to a remote location via the network interface for use in transforming the audio data product.

35. The system of claim 1, wherein the data processing resources include a processor which transforms the audio data product to the customized audio data product using the customer hearing profile, a memory device to store data on a machine readable medium, and logic for storing the customized audio data product on the machine readable medium.

36. The system of claim 1, wherein the processing resources comprise a processor coupled to a device for playing the customized audio data product.

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37. The system of claim 1, wherein the processing resources comprise a processor coupled to a network, and resources for transmitting the customized audio data product to the customer via the network.

38. The system of claim 1, wherein the data processing resources include an interface for reading a hearing profile from a portable data storage device.

39. A method for producing customized audio data, comprising:
providing an interface for access to an audio data product;
receiving a request for the audio data product from a customer;
receiving a customer hearing profile associated with the customer; and
associating the audio data product with the customer hearing profile for use in production of a customized audio data product.

40. The method of claim 39, including:
producing the customized audio data product in response to the audio data product and the customer hearing profile, and transmitting the customized audio data product to a remote site.

41. The method of claim 39, including:
producing the customized audio data product in response to the audio data product and the customer hearing profile, and storing the customized audio data product on a machine readable medium.

42. The method of claim 39, including:
producing the customized audio data product in response to the audio data product and the customer hearing profile, and transducing the customized audio data product to sound.

43. The method of claim 39, including transmitting the audio data product and the customer hearing profile to a remote site.

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44. The method of claim 39, wherein the customer hearing profile comprises coefficients of a transfer function to transform the audio data product according a psycho-acoustic characteristic of a customer.

45. The method of claim 39, wherein the customer hearing profile comprises an identifier of transfer function to transform the audio data product according a hearing characteristic of a customer.

46. The method of claim 39, wherein the customer hearing profile comprises an identifier of a transfer function and coefficients of the identified transfer function to transform the audio data product according a hearing characteristic of a customer.

47. The method of claim 39, including providing a machine readable registry of customer hearing profiles corresponding to registered customers of the audio data product, and further including reading, modifying and writing particular customer hearing profiles in the plurality to maintain the registry.

48. The method of claim 39, wherein the interface for access to the audio data product comprises a network interface.

49. The method of claim 39, including providing a source of a plurality of customer hearing profiles comprising a network interface.

50. The method of claim 39, wherein the audio data product comprises pre-recorded audio tracks.

51. The method of claim 39, wherein the audio data product comprises pre-recorded audio music tracks.

52. The method of claim 39, wherein the audio data product comprises live audio music streams.

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53. The method of claim 39, wherein the audio data product comprises pre-recorded audio voice tracks.

54. The method of claim 39, wherein the audio data product comprises live audio voice streams.

55. The method of claim 39, wherein the audio data product comprises live audio telephone data.

56. The method of claim 39, including providing an interface accessible via a network interface adapted to receive user input, including the request for the audio data product and an identifier of the customer hearing profile.

57. The method of claim 39, including providing tools by which a user selects an instance of the audio data product, and issues a request for the selected instance.

58. The method of claim 39, including providing a source of a plurality of customer hearing profiles, and tools by which a user adds a customer hearing profile to the plurality of customer hearing profiles.

59. The method of claim 39, including providing a source of a plurality of customer hearing profiles, and tools by which a user modifies a particular customer hearing profile in the plurality of customer hearing profiles.

60. The method of claim 39, including providing logic to produce information about billing for requested audio data products for customers.

61. The method of claim 39, wherein the audio data product comprises a digitally encoded product.

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62. The method of claim 39, wherein the audio data product comprises an analog encoded product.

63. The method of claim 39, wherein the audio data product comprises data encoded according to a particular format suitable for playback by audio devices adapted for the particular format, and the customized audio data product comprises data encoded according to the particular format.

64. The method of claim 39, including providing a source of a plurality of customer hearing profiles, and wherein a customer hearing profile in the plurality of customer hearing profiles includes a value indicating an audio device on which the customized audio data product is to be played.

65. The method of claim 39, wherein the customer hearing profile includes a value indicating a hearing characteristic type of a customer for whom the customized audio data product is to be played.

66. The method of claim 39, wherein the customer hearing profile includes a specification of psycho-acoustic characteristics of a customer for whom the customized audio data product is to be played.

67. The method of claim 39, wherein the customer hearing profile includes an audiogram of a customer for whom the customized audio data product is to be played.

68. The method of claim 39, wherein the customer hearing profile includes software defining a transfer function for producing the customized audio data product.

69. The method of claim 39, including providing a source of a plurality of customer hearing profiles, accepting data concerning a customer for whom the customized audio data product is to be played, and producing a customer hearing profile for the plurality of customer hearing profiles in response to the accepted data.

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70. The method of claim 39, including providing a source of a plurality of customer hearing profiles, accepting data via a network interface concerning a customer for whom the customized audio data product is to be played, and producing a customer hearing profile for the plurality of customer hearing profiles in response to the accepted data.

71. The method of claim 39, including providing a source of a plurality of customer hearing profiles, accepting data via a network interface, concerning a customer for whom the customized audio data product is to be played, and modifying a customer hearing profile in the plurality of customer hearing profiles in response to the accepted data.

72. The method of claim 39, including providing a source of a plurality of customer hearing profiles, providing an interface accessible to a user via a network interface to accept data concerning a customer for whom the customized audio data product is to be played, and producing a customer hearing profile for the plurality of customer hearing profiles in response to the accepted data.

73. The method of claim 39, including providing a source of a plurality of customer hearing profiles, providing an interface accessible to a user via a network interface to accept data concerning a customer for whom the customized audio data product is to be played, and modifying a customer hearing profile in the plurality of customer hearing profiles in response to the accepted data.

74. A method for providing customized audio data products, comprising:

accepting via a data network, machine readable orders from a customer for a particular audio data product;

associating a hearing profile for the customer with the particular audio data product;

modifying the particular audio data product according to the hearing profile to produce a customized audio data product; and

transmitting via a data network, a customized audio data product to the customer.

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75. The method of claim 74, wherein the customized audio data product comprises at least a portion of the hearing profile, and the particular audio data product for transformation according to the hearing profile at a remote site.

76. The method of claim 74, wherein the customized audio data product comprises a transformation according to the hearing profile of the particular audio data product.

77. The method of claim 74, including maintaining a registry of hearing profiles, and the step of associating a hearing profile for the customer with the particular audio data product includes retrieving the hearing profile from the registry.

78. The method of claim 77, including providing tools accessible via a network for gathering information about hearing characteristics of customers, and modifying hearing profiles in the registry in response to the information.

79. The method of claim 77, including providing tools accessible via a network for gathering information about hearing characteristics of customers, and modifying hearing profiles in the registry in response to the information according to an optimization modeling process.

80. The method of claim 74, wherein the particular audio data product comprises pre-recorded audio tracks.

81. The method of claim 74, wherein the particular audio data product comprises pre-recorded audio music tracks.

82. The method of claim 74, wherein the particular audio data product comprises live audio music streams.

83. The method of claim 74, wherein the particular audio data product comprises pre-recorded audio voice tracks.

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84. The method of claim 74, wherein the particular audio data product comprises live audio voice streams.

85. The method of claim 74, wherein the particular audio data product comprises live audio telephone data.

86. The method of claim 74, including providing an interface accessible via a network interface adapted to receive user input, including the request for the particular audio data product and an identifier of the customer hearing profile.

87. The method of claim 74, including providing tools by which a user selects an instance of the particular audio data product, and issues a request for the selected instance.

88. The method of claim 74, including providing a source of a plurality of customer hearing profiles, and tools by which a user adds a customer hearing profile to the plurality of customer hearing profiles.

89. The method of claim 74, including providing a source of a plurality of customer hearing profiles, and tools by which a user modifies a particular customer hearing profile in the plurality of customer hearing profiles.

90. The method of claim 74, including providing logic to produce information about billing for particular audio data products for customers.

91. The method of claim 74, wherein the particular audio data product comprises a digitally encoded product.

92. The method of claim 74, wherein the particular audio data product comprises an analog encoded product.

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93. The method of claim 74, wherein the particular audio data product comprises data encoded according to a particular format suitable for playback by audio devices adapted for the particular format, and the customized audio data product comprises data encoded according to the particular format.

94. The method of claim 74, wherein the hearing profile includes a value indicating listening conditions in which the customized audio data product is to be played.

95. The method of claim 74, wherein the hearing profile includes a value indicating a hearing characteristic type of a customer for whom the customized audio data product is to be played.

96. The method of claim 74, wherein the hearing profile includes a specification of psycho-acoustic characteristics of a customer for whom the customized audio data product is to be played.

97. The method of claim 74, wherein the hearing profile includes an audiogram of a customer for whom the customized audio data product is to be played.

98. The method of claim 74, wherein the hearing profile includes software defining a transfer function for producing the customized audio data product.

99. A method for providing customized audio data products, comprising:
storing a machine readable hearing profile for a customer;
accepting via a data network, machine readable orders from the customer for a particular audio data product;
associating the hearing profile for the customer with the particular audio data product;
modifying the particular audio data product according to the hearing profile to produce a customized audio data product;
delivering the customized audio data product to the customer;
accepting feedback from the customer concerning the customized audio data product; and

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modifying the hearing profile in response to the feedback.

100. The method of claim 99, including:

providing input tools for accepting input data concerning a hearing profile for the customer, and producing the machine readable hearing profile in response to the input data.

101. The method of claim 99, including:

providing a graphical user interface, accessible by the customer, for accepting input data concerning a hearing profile for the customer, and producing the machine readable hearing profile in response to the input data.

102. The method of claim 99, including:

providing a graphical user interface, accessible by the customer via a data network, for accepting input data concerning a hearing profile for the customer, and producing the machine readable hearing profile in response to the input data.

103. The method of claim 99, including:

providing input tools for accepting input data characterizing the feedback, and modifying the machine readable hearing profile in response to the input data.

104. The method of claim 99, including:

providing a graphical user interface, accessible by the customer, for accepting input data characterizing the feedback, and modifying the machine readable hearing profile in response to the input data.

105. The method of claim 99, including:

providing a graphical user interface, accessible by the customer via a data network, for accepting input data characterizing the feedback, and modifying the machine readable hearing profile in response to the input data.

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106. The method of claim 99, wherein the step of modifying comprises applying an optimization modeling process to the hearing profile.

107. The method of claim 99, including maintaining a database including a plurality of machine readable hearing profiles for a corresponding plurality of customers, and wherein the step of modifying comprises applying an optimization modeling process to the hearing profile in response to the feedback and to the database.

108. The method of claim 99, including determining listening conditions relevant to playback of the customized audio data product, and wherein the step of modifying is responsive to the determined listening conditions.

109. The method of claim 99, including determining a type of delivery for the customized audio data product, and wherein the step of delivering is responsive to the determined type of delivery.

110. The method of claim 99, including determining a type of delivery for the customized audio data product, and wherein the step of modifying is responsive to the determined type of delivery.

111. A method for providing customized audio data products, comprising:
reading a particular audio data product;
associating a hearing profile with the particular audio data product;
modifying the particular audio data product according to the hearing profile to produce a customized audio data product.

112. The method of claim 111, wherein the step of associating a hearing profile with the particular audio data product includes retrieving the hearing profile from a portable memory device.

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113. The method of claim 111 including maintaining a registry of hearing profiles, and the step of associating a hearing profile for the customer with the particular audio data product includes retrieving the hearing profile from the registry.

114. The method of claim 113, including providing tools accessible via a network for gathering information about hearing characteristics of customers, and modifying hearing profiles in the registry in response to the information.

115. The method of claim 113, including providing tools accessible via a network for gathering information about hearing characteristics of customers, and modifying hearing profiles in the registry in response to the information according to an optimization modeling process.

116. The method of claim 111, wherein the particular audio data product comprises pre-recorded audio tracks.

117. The method of claim 111, wherein the particular audio data product comprises pre-recorded audio music tracks.

118. The method of claim 111, wherein the particular audio data product comprises live audio music streams.

119. The method of claim 111, wherein the particular audio data product comprises pre-recorded audio voice tracks.

120. The method of claim 111, wherein the particular audio data product comprises live audio voice streams.

121. The method of claim 111, wherein the particular audio data product comprises live audio telephone data.

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122. The method of claim 111, including providing tools by which a user selects an instance of the particular audio data product, and issues a request for the selected instance.

123. The method of claim 111, including providing a source of a plurality of customer hearing profiles, and tools by which a user adds a customer hearing profile to the plurality of customer hearing profiles.

124. The method of claim 111, including providing a source of a plurality of customer hearing profiles, and tools by which a user modifies a particular customer hearing profile in the plurality of customer hearing profiles.

125. The method of claim 111, wherein the particular audio data product comprises a digitally encoded product.

126. The method of claim 111, wherein the particular audio data product comprises an analog encoded product.

127. The method of claim 111, wherein the particular audio data product comprises data encoded according to a particular format suitable for playback by audio devices adapted for the particular format, and the customized audio data product comprises data encoded according to the particular format.

128. The method of claim 111, wherein the hearing profile includes a value indicating listening conditions in which the customized audio data product is to be played.

129. The method of claim 111, wherein the hearing profile includes a value indicating a hearing characteristic type of a customer for whom the customized audio data product is to be played.

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130. The method of claim 111, wherein the hearing profile includes a specification of psycho-acoustic characteristics of a customer for whom the customized audio data product is to be played.

131. The method of claim 111, wherein the hearing profile includes an audiogram of a customer for whom the customized audio data product is to be played.

132. The method of claim 111, wherein the hearing profile includes software defining a transfer function for producing the customized audio data product.

133. A device for producing customized audio data, comprising:
data storage storing an audio data product and
a hearing profile of a customer for the audio data product; and
logic to produce a customized audio data product in response to the hearing profile and the audio data product.

134. The device of claim 133, including:
an interface by which the customized audio data product is received from a remote site.

135. The device of claim 133, including:
logic to store the customized audio data product on a machine readable medium.

136. The device of claim 133, wherein the customized audio data product comprises at least a portion of the hearing profile, and the audio data product for transformation according to the hearing profile at a remote site.

137. The device of claim 133, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product.

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138. The device of claim 133, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product, and a parameter used for decoding the transformation.

139. The device of claim 133, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product, and a parameter associated with the customer used for decoding the transformation.

140. An article of manufacture comprising:

a data storage medium configured for connection to, and for disconnection from, an audio playback device; and

a customized audio data product stored in the data storage medium, the customized audio data product comprising an audio data product customized in response to a hearing profile of a customer.

141. The article of claim 140, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product, and a parameter for identification of the customer.

142. The article of claim 140, wherein the customized audio data product comprises at least a portion of the hearing profile, and the audio data product for transformation according to the hearing profile.

143. The article of claim 140, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product.

144. The article of claim 140, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product, and a parameter used for decoding the transformation.

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145. The article of claim 140, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product, and a parameter associated with the customer used for decoding the transformation.

146. An audio data playback device comprising:

a data processor;

a data storage medium, coupled to the data processor;

an audio transducer, coupled to the data processor; and

a customized audio data product stored in the data storage medium, the customized audio data product comprising an audio data product customized using a hearing profile of a customer.

147. The audio data playback device of claim 146, wherein the audio transducer comprises a speaker mounted on a headset.

148. The audio data playback device of claim 146, wherein the audio transducer comprises stereo speakers mounted on a headset.

149. The audio data playback device of claim 146, wherein the customized audio data product comprises the audio data product transformed according to the hearing profile, and a parameter for identification of the customer.

150. The audio data playback device of claim 146, wherein the customized audio data product comprises a transformation according to the hearing profile of the audio data product, and a parameter associating the customized audio data product with the customer, and the data processor includes decoding logic responsive to the parameter for playing the customized audio data product.

151. The audio data playback device of claim 146, wherein the customized audio data product comprises at least a portion of the hearing profile, and the audio data product for transformation according to the hearing profile, and the data processor includes decoding logic

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responsive to said at least a portion of the hearing profile for playing the customized audio data product.

152. An audio testing device comprising:

a data processor;

a data storage medium, coupled to the data processor;

a communication port, coupled to the data processor;

an audio transducer, coupled to the data processor; and

at least a portion of a hearing test program stored in the data storage medium, the hearing test program comprising routines for execution of a hearing test using the communication port and the hearing test program to produce hearing profile data of a customer.

153. The audio testing device of claim 152, wherein the communication port comprises a port for connection to an external data processing device providing a user interface for the hearing test program.

154. The audio testing device of claim 152, wherein the audio transducer comprises a speaker mounted on a headset.

155. The audio testing device of claim 152, wherein the audio transducer comprises stereo speakers mounted on a headset.

156. The audio testing device of claim 152, including a port adapted to couple a removable data storage device to the data processor, and resources for playing an audio data product stored in the removable data storage device.

157. The audio testing device of claim 152, including a battery, and wherein the data processor and audio transducer are coupled to the battery.

Apple Inc. Exhibit 1002 Page 1180

158. The audio testing device of claim 152, including a headset, and wherein the data processor, data storage medium, communication port and audio transducer are mounted on the headset.

159. The audio testing device of claim 152, wherein the customer hearing profile comprises coefficients of a transfer function to transform an audio data product according a hearing characteristic of a customer.

160. The audio testing device of claim 152, wherein the customer hearing profile comprises an identifier of transfer function to transform an audio data product according a hearing characteristic of a customer.

161. The audio testing device of claim 152, wherein the customer hearing profile comprises an identifier of a transfer function and coefficients of the identified transfer function to transform an audio data product according a hearing characteristic of a customer.

162. The audio testing device of claim 152, wherein the customer hearing profile includes a value indicating listening conditions in which a customized audio data product is to be played.

163. The audio testing device of claim 152, wherein the customer hearing profile includes a value indicating a hearing characteristic of a customer for whom a customized audio data product is to be played.

164. The audio testing device of claim 152, wherein the customer hearing profile includes a specification of psycho-acoustic characteristics of a customer for whom a customized audio data product is to be played.

165. The audio testing device of claim 152, wherein the customer hearing profile includes an audiogram characterizing a customer for whom a customized audio data product is to be played.

Apple Inc. Exhibit 1002 Page 1181

166. The audio testing device of claim 152, wherein the customer hearing profile includes software defining a transfer function for producing a customized audio data product.

167. An audio testing and playback device comprising:

a data processor;

data memory coupled to the data processor;

a communication port, coupled to the data processor;

an audio transducer, coupled to the data processor;

a hearing test program stored in the data memory, the hearing test program comprising logic used for execution of a hearing test using the communication port to produce hearing profile data for use in production of a hearing profile of a customer; and

a customized audio data product stored in the data memory, the customized audio data product comprising an audio data product customized using the hearing profile.

168. The audio testing and playback device of claim 167, wherein the communication port comprises a port for connection to an external data processing device providing a user interface for the hearing test program.

169. The audio testing and playback device of claim 167, wherein the audio transducer comprises a speaker mounted on a headset.

170. The audio testing and playback device of claim 167, wherein the audio transducer comprises stereo speakers mounted on a headset.

171. The audio testing and playback device of claim 167, including a port adapted to couple a removable data storage device to the data processor, and resources for playing an audio data product stored in the removable data storage device.

172. The audio testing and playback device of claim 167, including a battery, and wherein the data processor and audio transducer are coupled to the battery.

Apple Inc. Exhibit 1002 Page 1182

173. The audio testing and playback device of claim 167, including a headset, and wherein the data processor, data memory, communication port and audio transducer are mounted on the headset.

174. A method for conducting a hearing test, comprising:

providing a headset having stored therein audio test software;

coupling the headset to a data processor having a user interface;

executing a test using the audio test software and the user interface to develop a hearing profile;

producing a customized audio data product using the hearing profile; and

playing the customized audio data product on the headset.

175. The method of claim 174, including storing the hearing profile on the headset, and wherein the step of producing a customized audio data product comprises processing an audio data product using the hearing profile stored in the headset.

176. The method of claim 174, including storing the hearing profile in a remote site.

177. The method of claim 174, including producing the customized audio data product in a remote site.

178. The method of claim 174, including storing the customized audio data product on a machine readable medium, and coupling the machine readable medium to the headset.

179. The method of claim 174, including storing the customized audio data product on a portable data storage device, and coupling the portable data storage device to the headset.

180. An article of manufacture comprising:

a data storage medium configured for connection to, and for disconnection from, an audio playback device; and

a customer hearing profile stored in the data storage medium, the hearing profile comprising data generated based on hearing characteristics of a particular customer.

181. The article of claim 180, wherein the customer hearing profile comprises coefficients of a transfer function to transform an audio data product according a hearing characteristic of a customer.

182. The article of claim 180, wherein the customer hearing profile comprises an identifier of a transfer function to transform an audio data product according a hearing characteristic of a customer.

183. The article of claim 180, wherein the customer hearing profile comprises an identifier of a transfer function and coefficients of the identified transfer function to transform an audio data product according a hearing characteristic of a customer.

184. The article of claim 180, wherein the customer hearing profile includes a value indicating listening conditions in which a customized audio data product is to be played.

185. The article of claim 180, wherein the customer hearing profile includes a value indicating a hearing characteristic of a customer for whom a customized audio data product is to be played.

186. The article of claim 180, wherein the customer hearing profile includes a specification of psycho-acoustic characteristics of a customer for whom a customized audio data product is to be played.

187. The article of claim 180, wherein the customer hearing profile includes an audiogram characterizing a customer for whom a customized audio data product is to be played.

188. The article of claim 180, wherein the customer hearing profile includes software defining a transfer function for producing a customized audio data product.

Apple Inc. Exhibit 1002 Page 1184

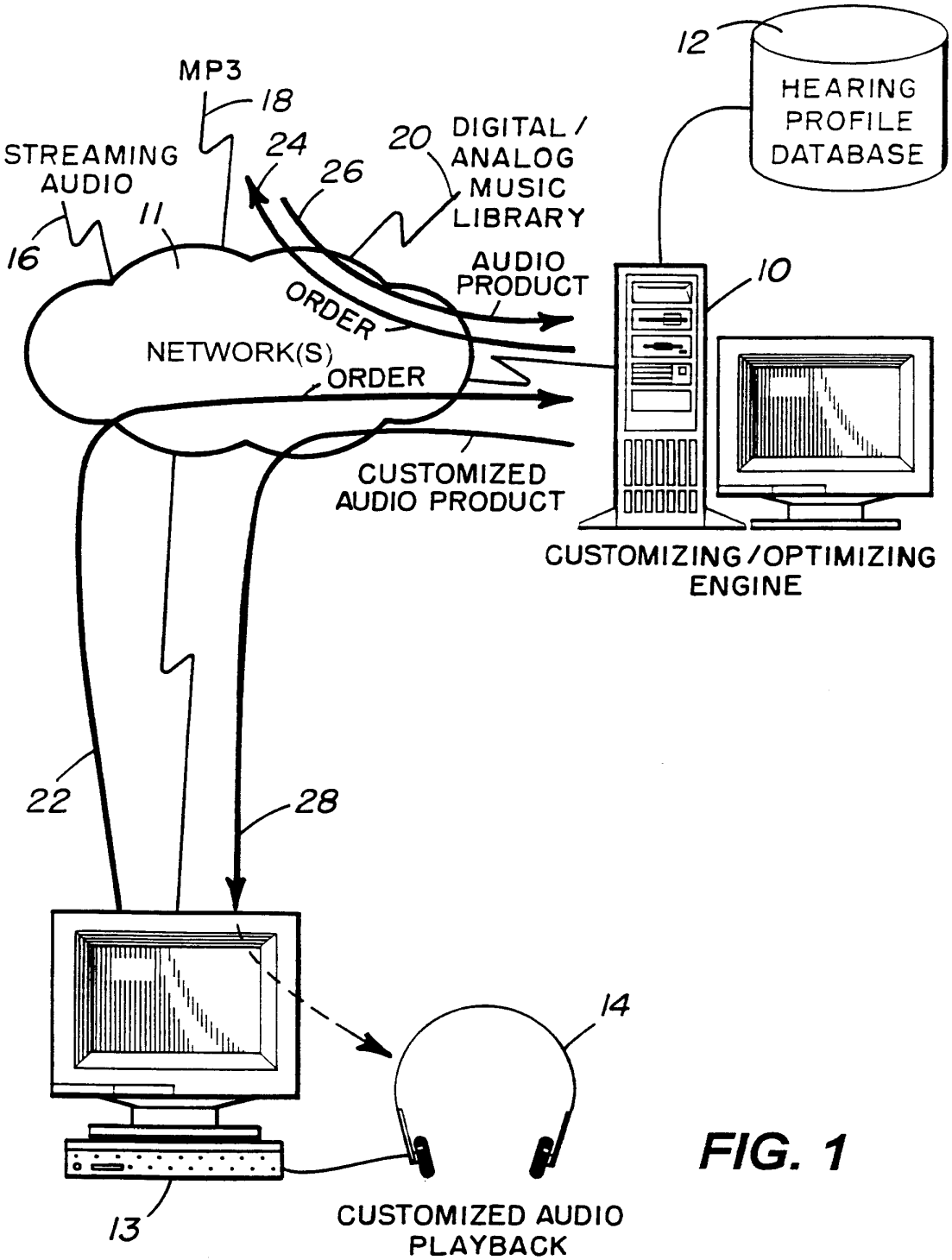

12
HEARING PROFILE DATABASE
MP3
18
STREAMING AUDIO
16
11
24
26
20
DIGITAL / ANALOG MUSIC LIBRARY
AUDIO PRODUCT
ORDER
NETWORK(S)
ORDER
10
CUSTOMIZED AUDIO PRODUCT
CUSTOMIZING/OPTIMIZING ENGINE
22
28
14
13
CUSTOMIZED AUDIO PLAYBACK

FIG. 1

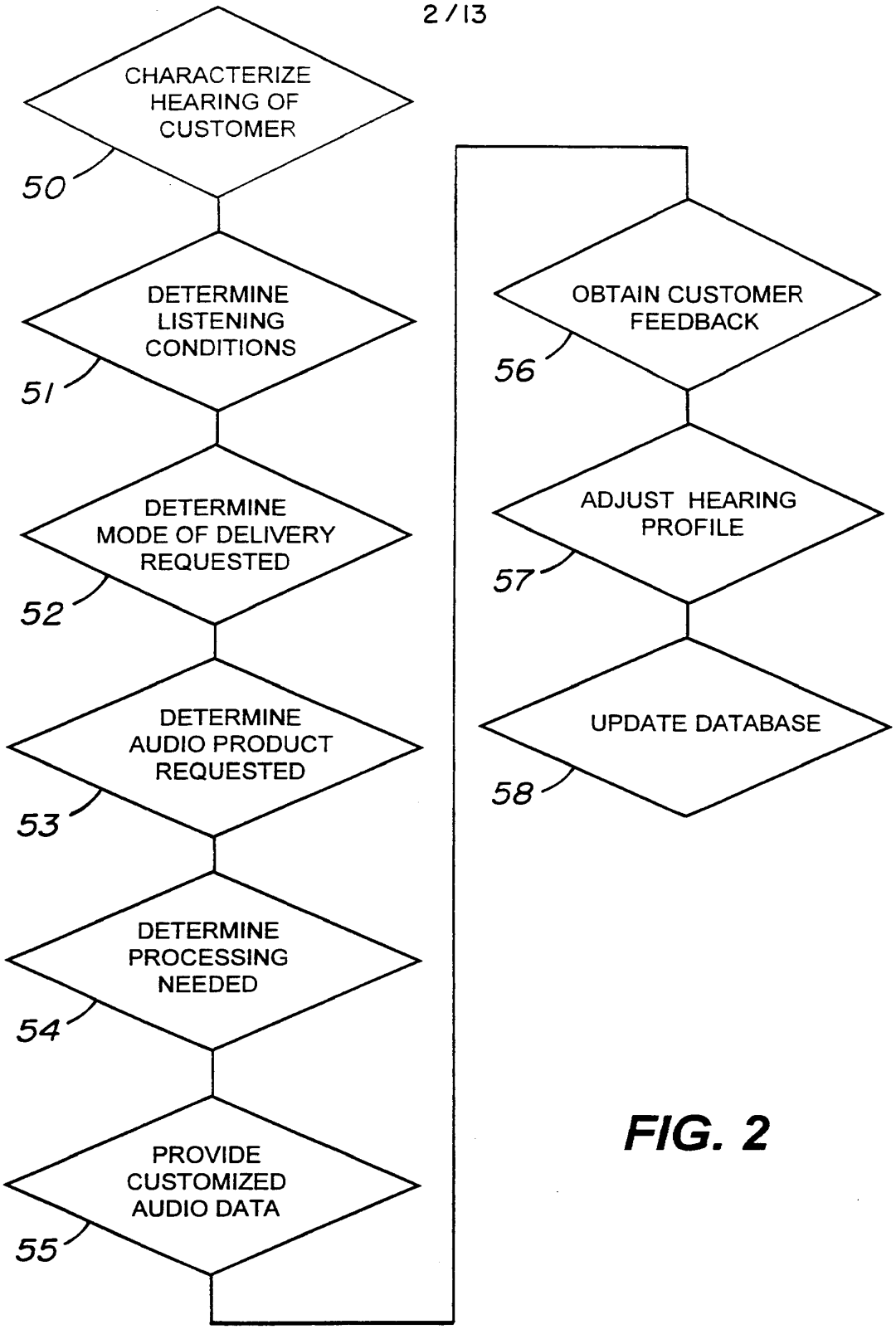

CHARACTERIZE HEARING OF CUSTOMER
50
DETERMINE LISTENING CONDITIONS
51
DETERMINE MODE OF DELIVERY REQUESTED
52
DETERMINE AUDIO PRODUCT REQUESTED
53
DETERMINE PROCESSING NEEDED
54
PROVIDE CUSTOMIZED AUDIO DATA
55
OBTAIN CUSTOMER FEEDBACK
56
ADJUST HEARING PROFILE
57
UPDATE DATABASE
58

FIG. 2

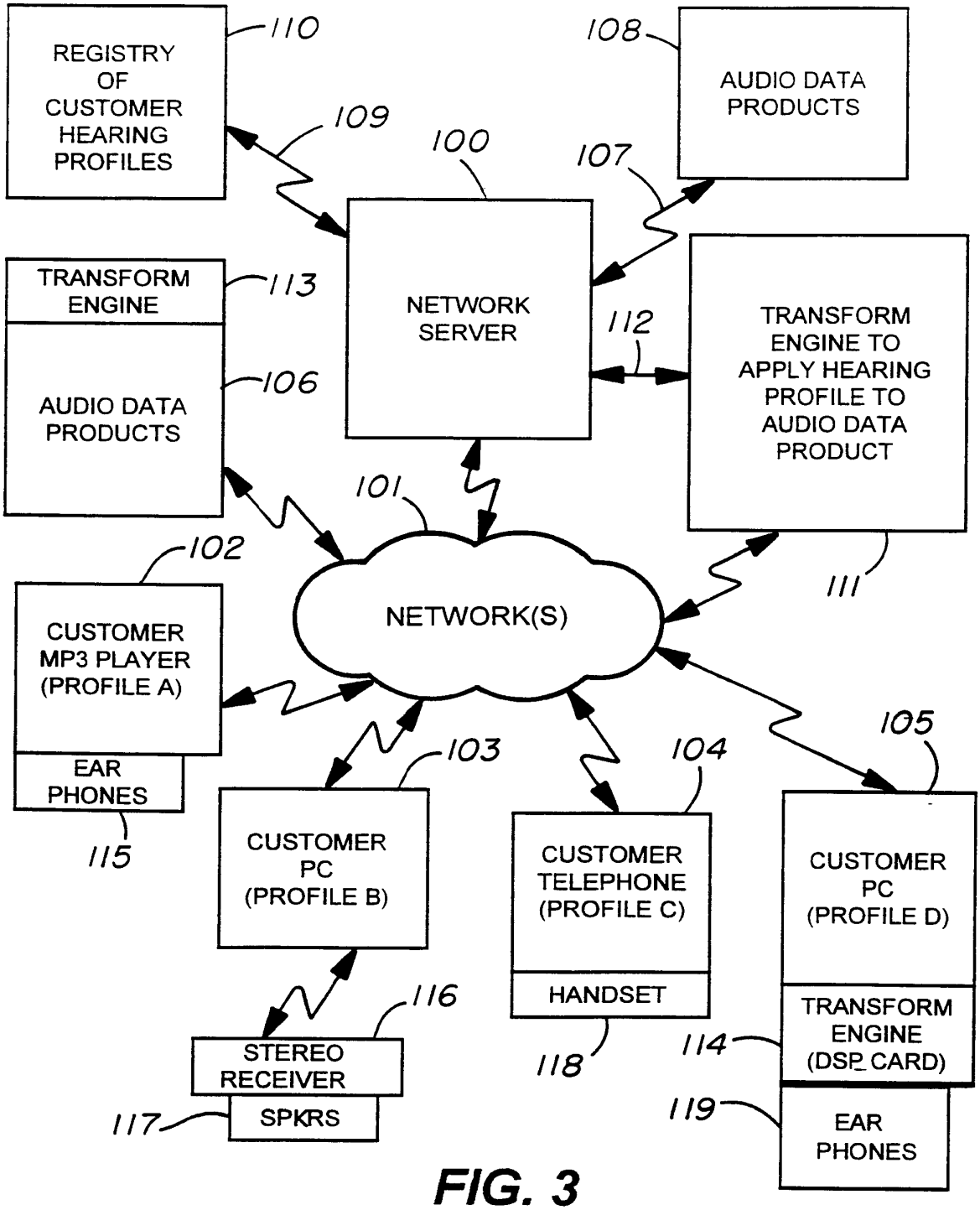

REGISTRY OF CUSTOMER HEARING PROFILES
110
109
100
108
AUDIO DATA PRODUCTS
107
NETWORK SERVER
TRANSFORM ENGINE
113
AUDIO DATA PRODUCTS
106
112
TRANSFORM ENGINE TO APPLY HEARING PROFILE TO AUDIO DATA PRODUCT
101
102
NETWORK(S)
111
CUSTOMER MP3 PLAYER (PROFILE A)
EAR PHONES
115
103
104
105
CUSTOMER PC (PROFILE B)
CUSTOMER TELEPHONE (PROFILE C)
HANDSET
118
CUSTOMER PC (PROFILE D)
TRANSFORM ENGINE (DSP CARD)
114
EAR PHONES
119
116
STEREO RECEIVER
SPKRS
117

FIG. 3

FIG. 4

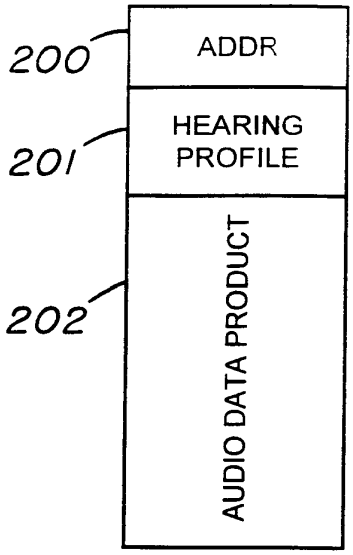
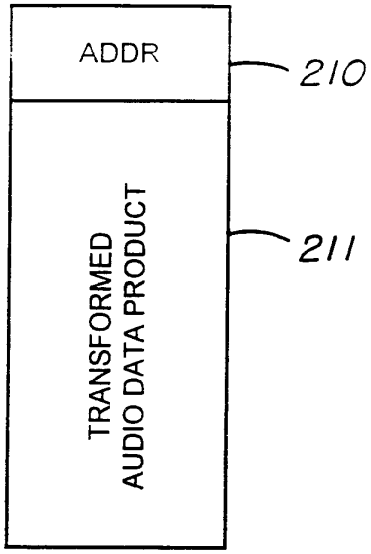


FIG. 5



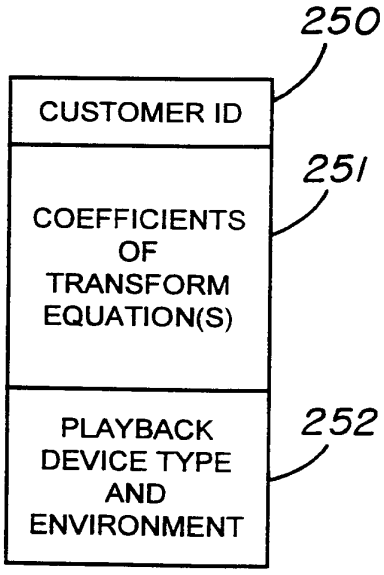
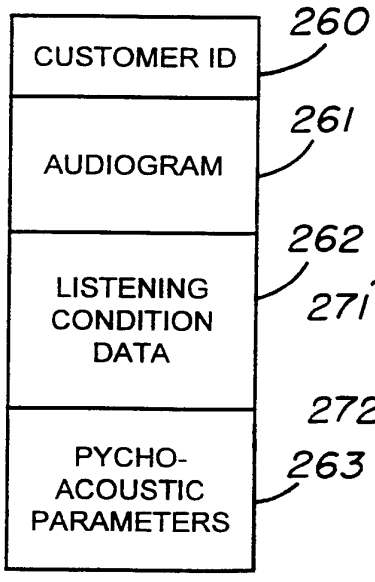


FIG. 6



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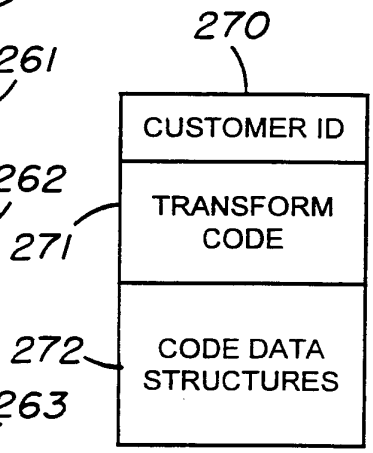


FIG. 8

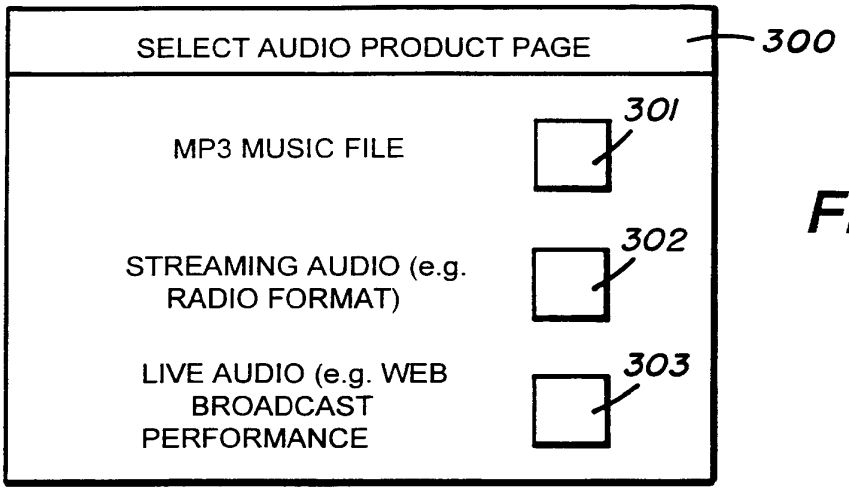


FIG. 9

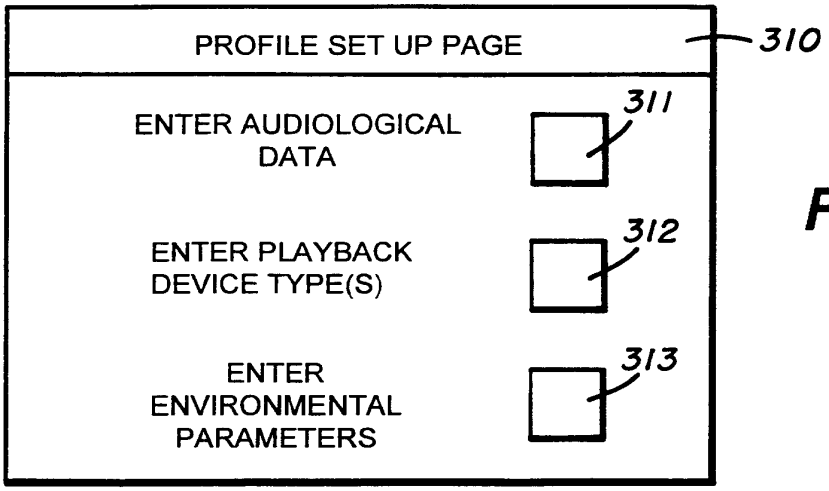


FIG. 10

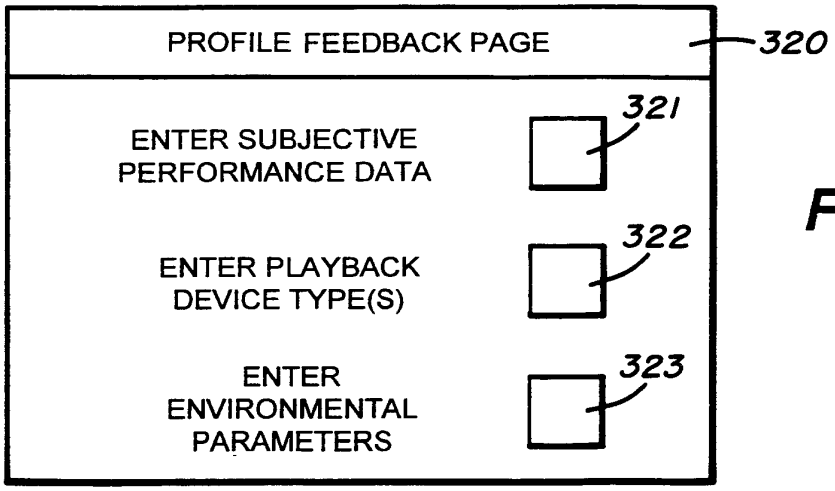
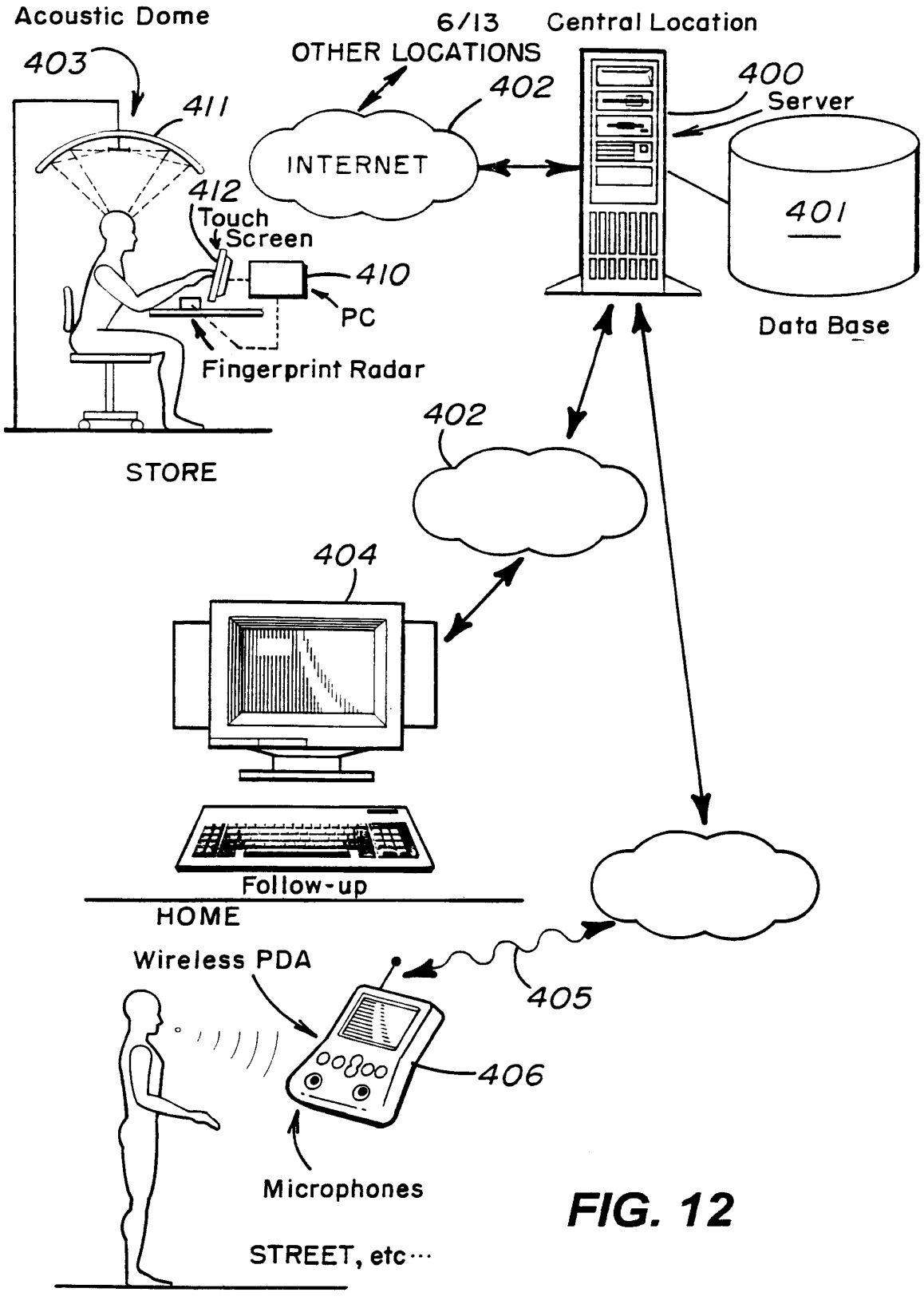


FIG. 11


Acoustic Dome
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411
412
Touch Screen
410
PC
Fingerprint Radar
STORE
6/13
OTHER LOCATIONS
402
INTERNET
Central Location
400
Server
401
Data Base
402
404
Follow-up
HOME
Wireless PDA
405
406
Microphones
STREET, etc···

FIG. 12

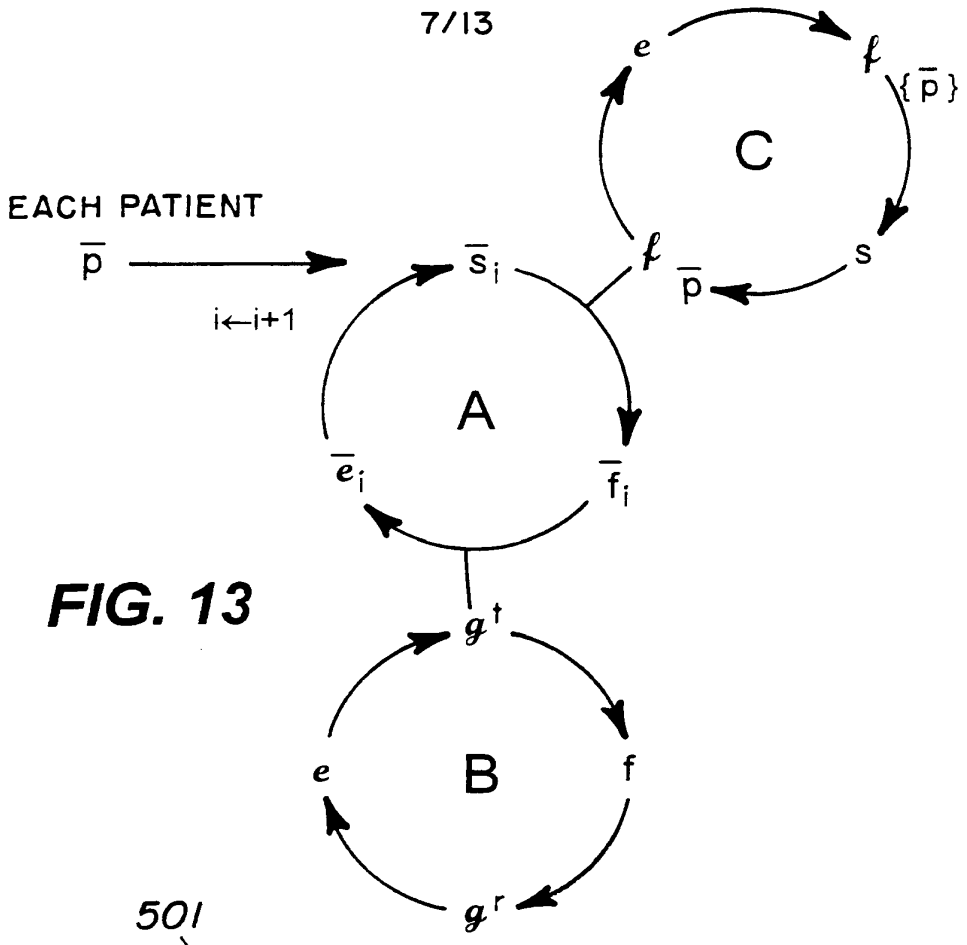
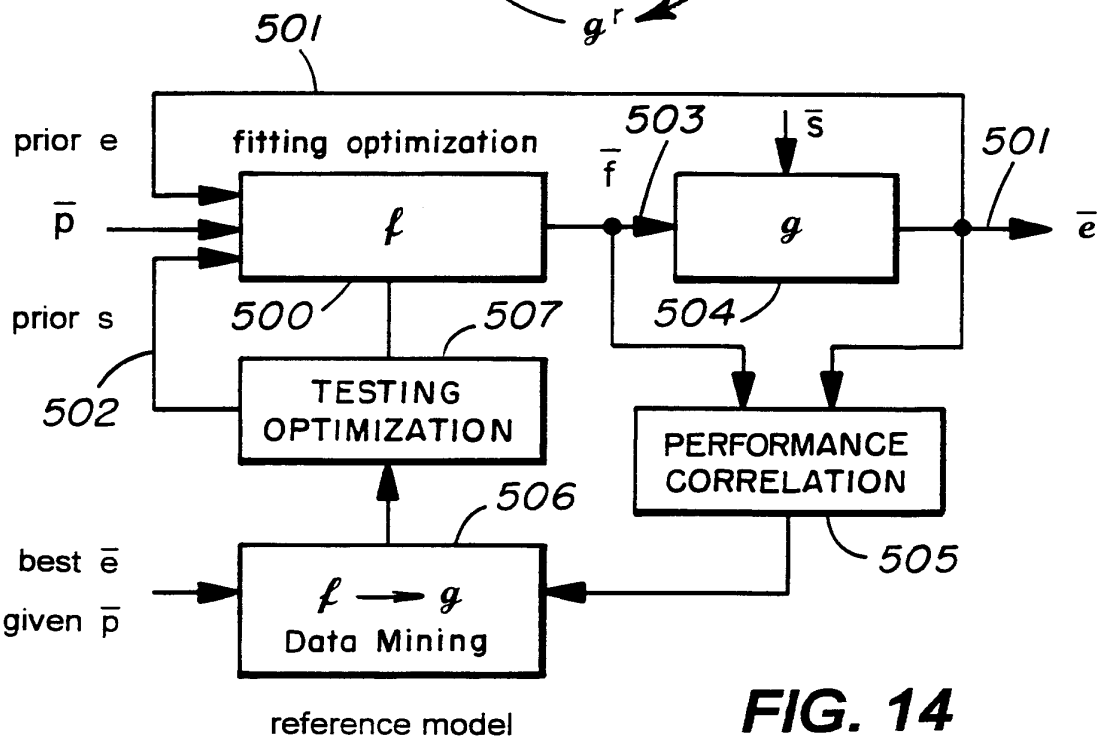

EACH PATIENT
p
i←i+1
s_i
e_i
f_i
A
e
f
{p}
C
f
p
s
g^t
e
B
f
g^r

FIG. 13


501
prior e
fitting optimization
503
s
501
p
f
f
g
e
prior s
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504
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TESTING OPTIMIZATION
PERFORMANCE CORRELATION
506
505
best e
given p
f → g
Data Mining
reference model

FIG. 14

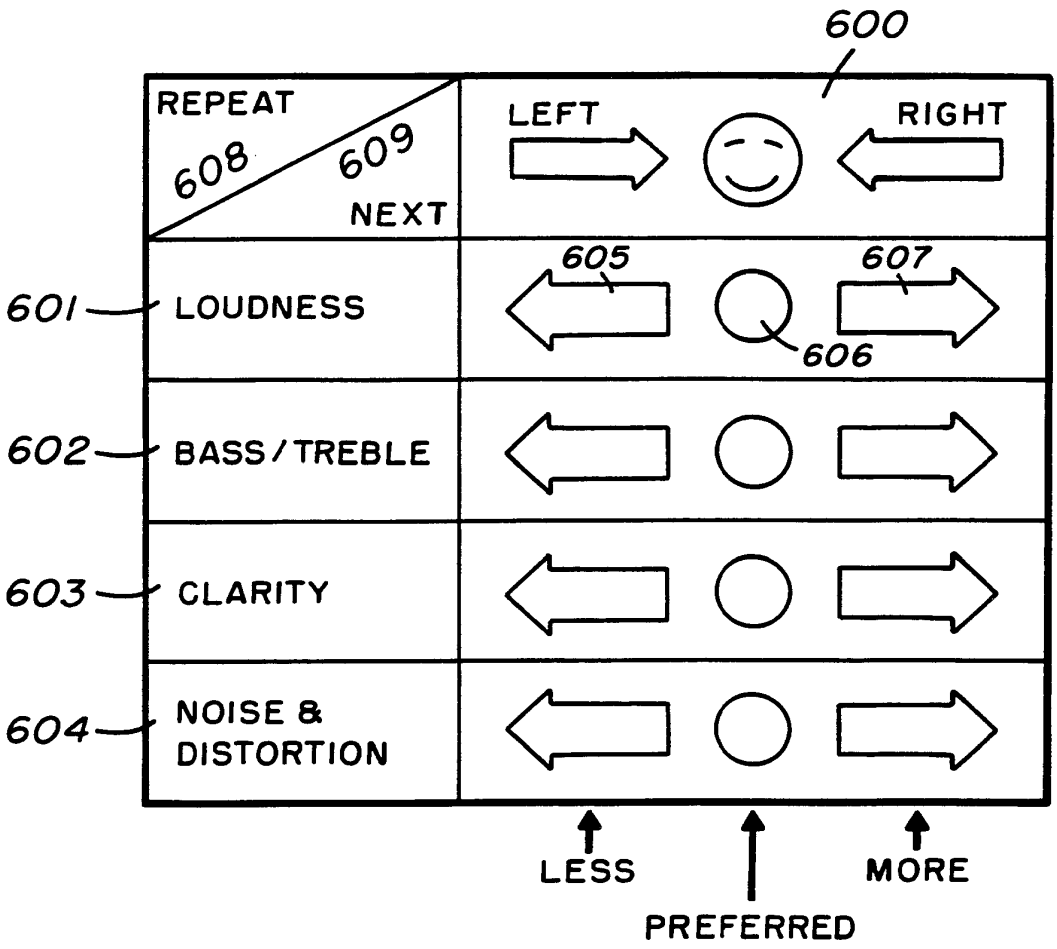

600
REPEAT
608
609
NEXT
LEFT
RIGHT
601
LOUDNESS
605
607
606
602
BASS / TREBLE
603
CLARITY
604
NOISE &
DISTORTION
LESS
MORE
PREFERRED

FIG. 15

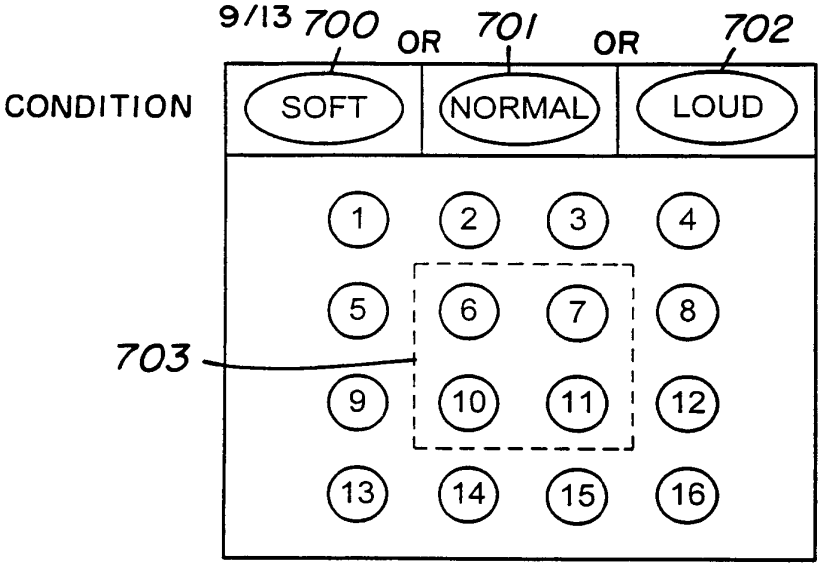


FIG. 16

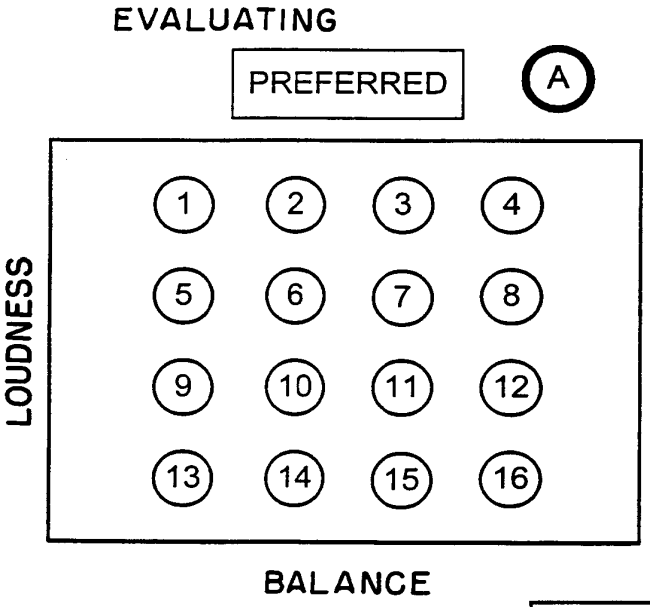


FIG. 17

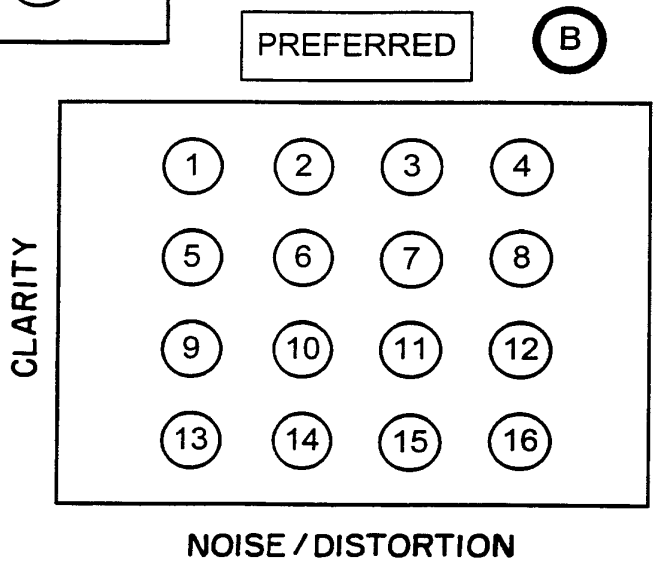
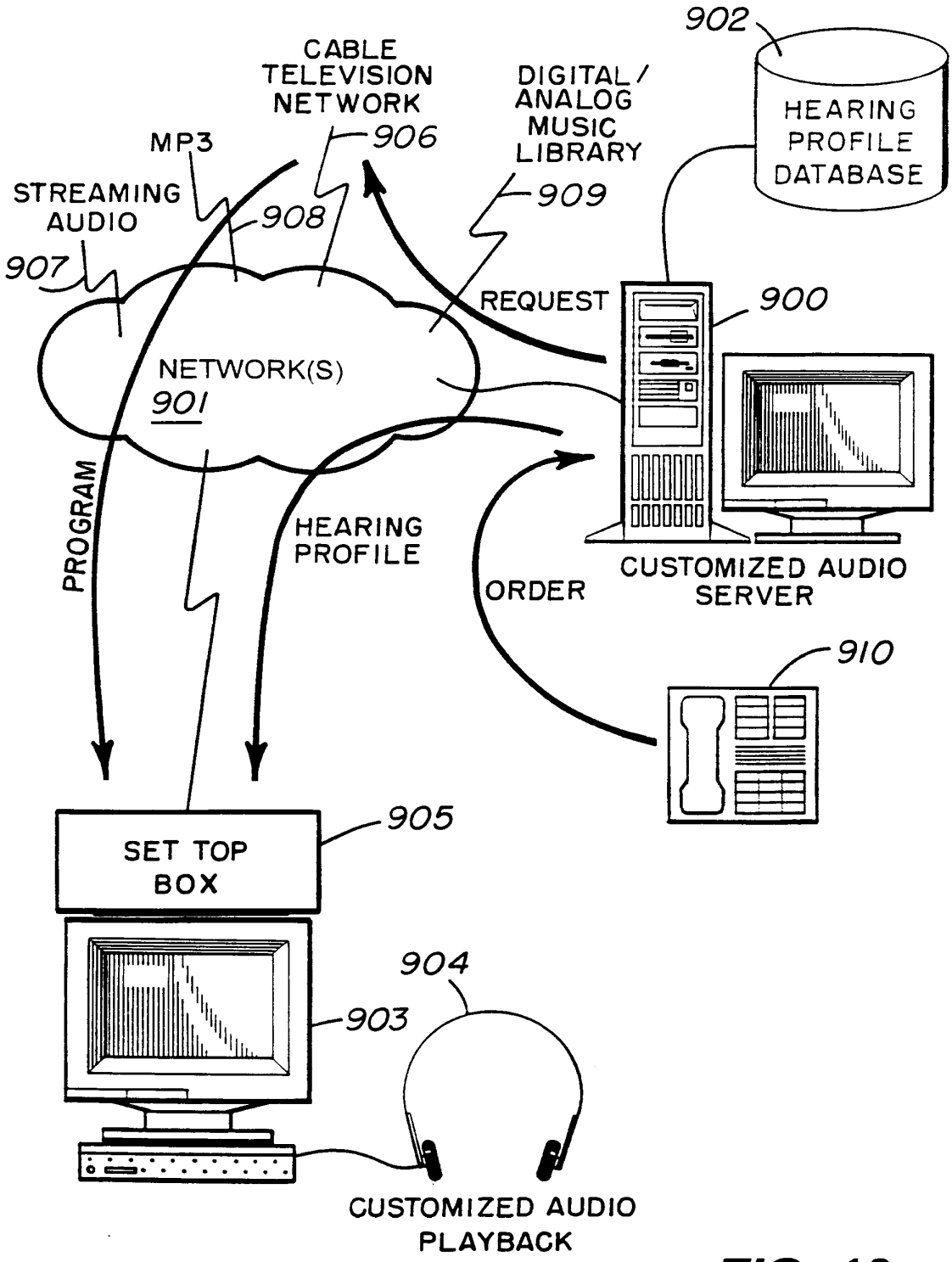


FIG. 18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DIGITAL / ANALOG MUSIC LIBRARY
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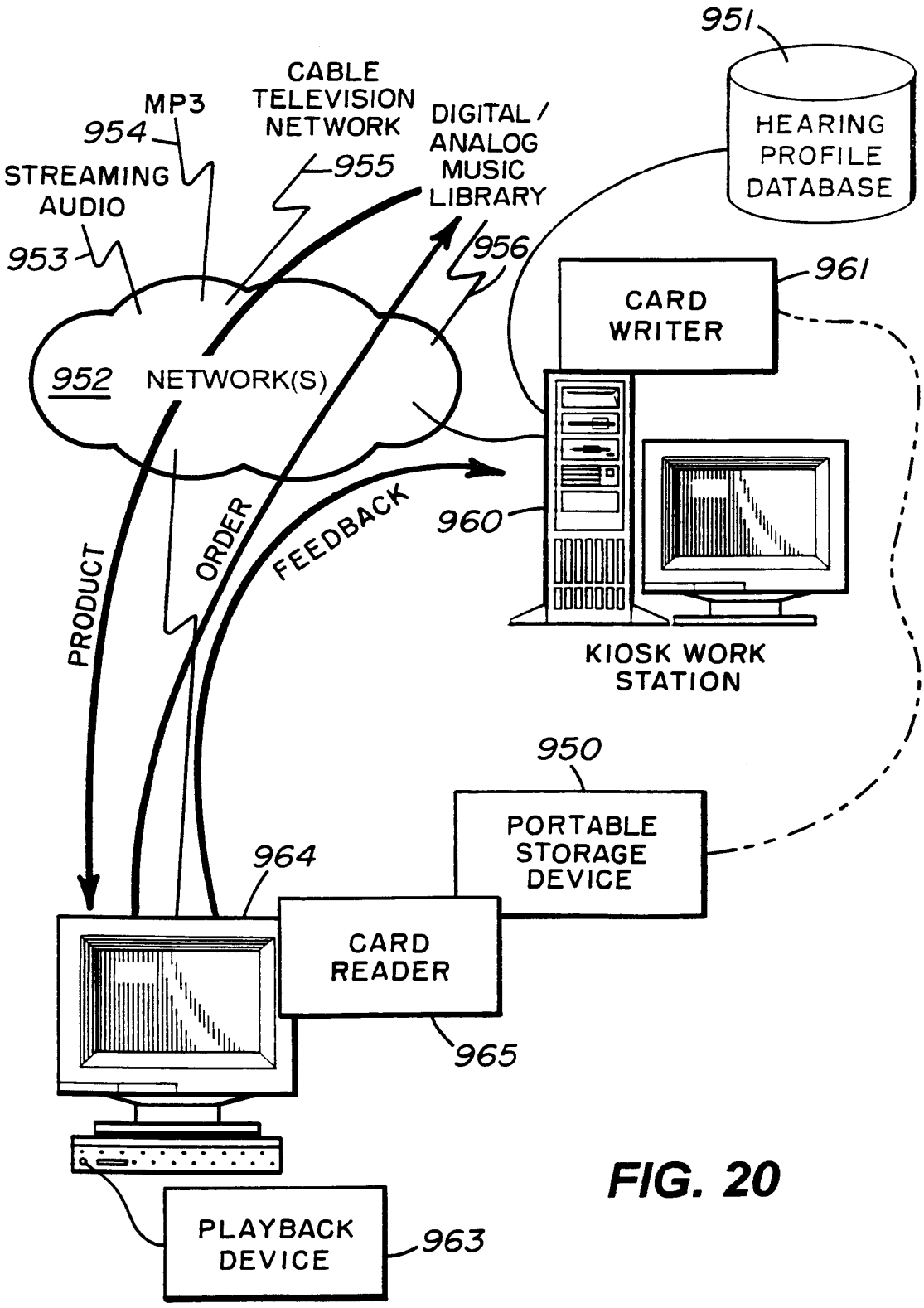
MP3
908
STREAMING AUDIO
907
REQUEST
900
NETWORK(S)
901
PROGRAM
HEARING PROFILE
ORDER
CUSTOMIZED AUDIO SERVER
910
905
SET TOP BOX
904
903
CUSTOMIZED AUDIO PLAYBACK

FIG. 19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DIGITAL / ANALOG MUSIC LIBRARY
STREAMING AUDIO
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953
956
961
CARD WRITER
952 NETWORK(S)
PRODUCT
ORDER
FEEDBACK
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KIOSK WORK STATION
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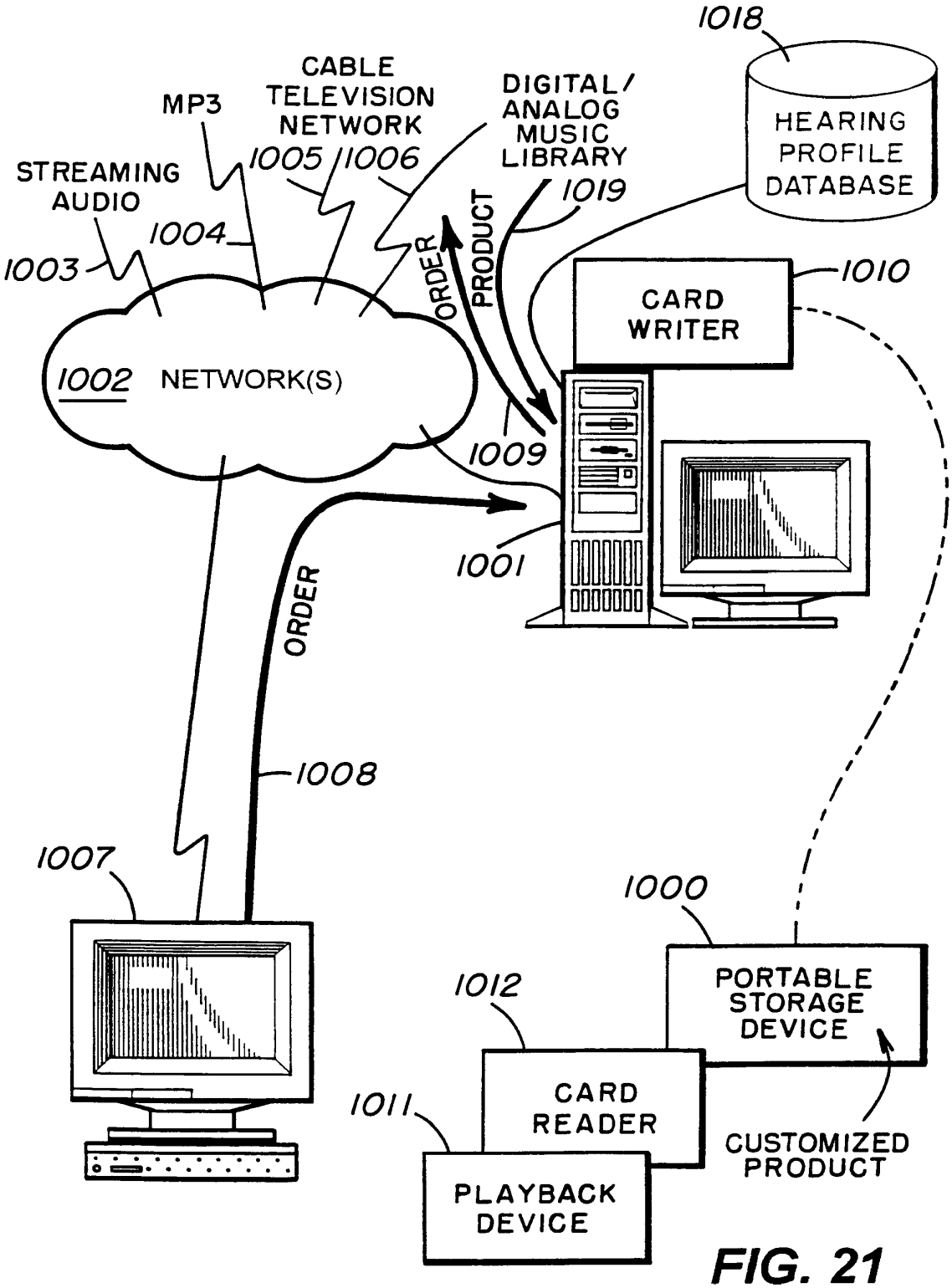
CARD READER
965
PLAYBACK DEVICE
963

FIG. 20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STREAMING AUDIO
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1006
1019
1004
1003
ORDER
PRODUCT
1010
CARD WRITER
1002 NETWORK(S)
1009
1001
ORDER
1008
1007
1000
1012
PORTABLE STORAGE DEVICE
CARD READER
1011
CUSTOMIZED PRODUCT
PLAYBACK DEVICE

FIG. 21

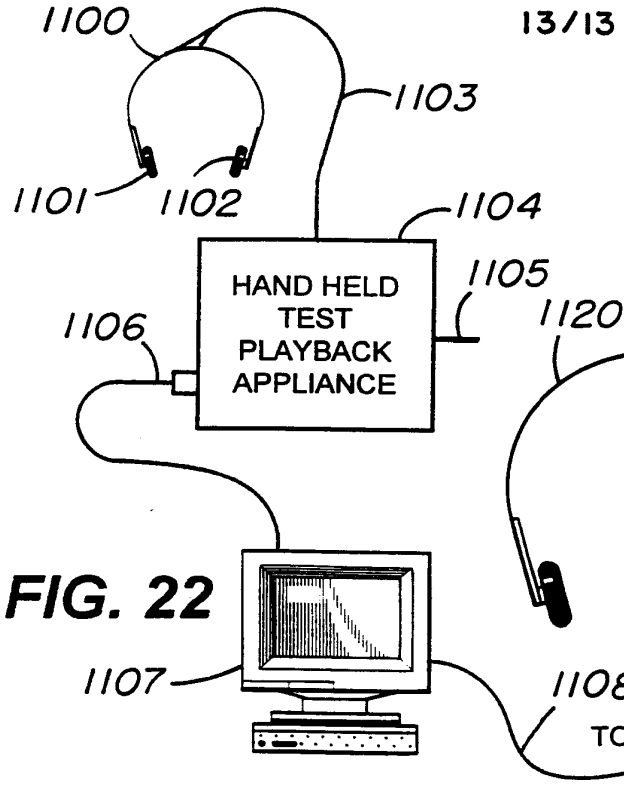

FIG. 22

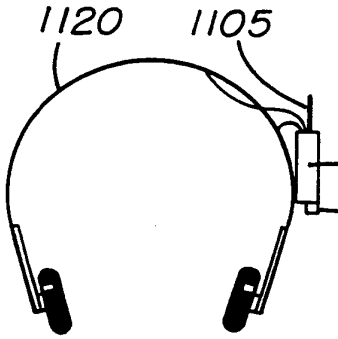

FIG. 23

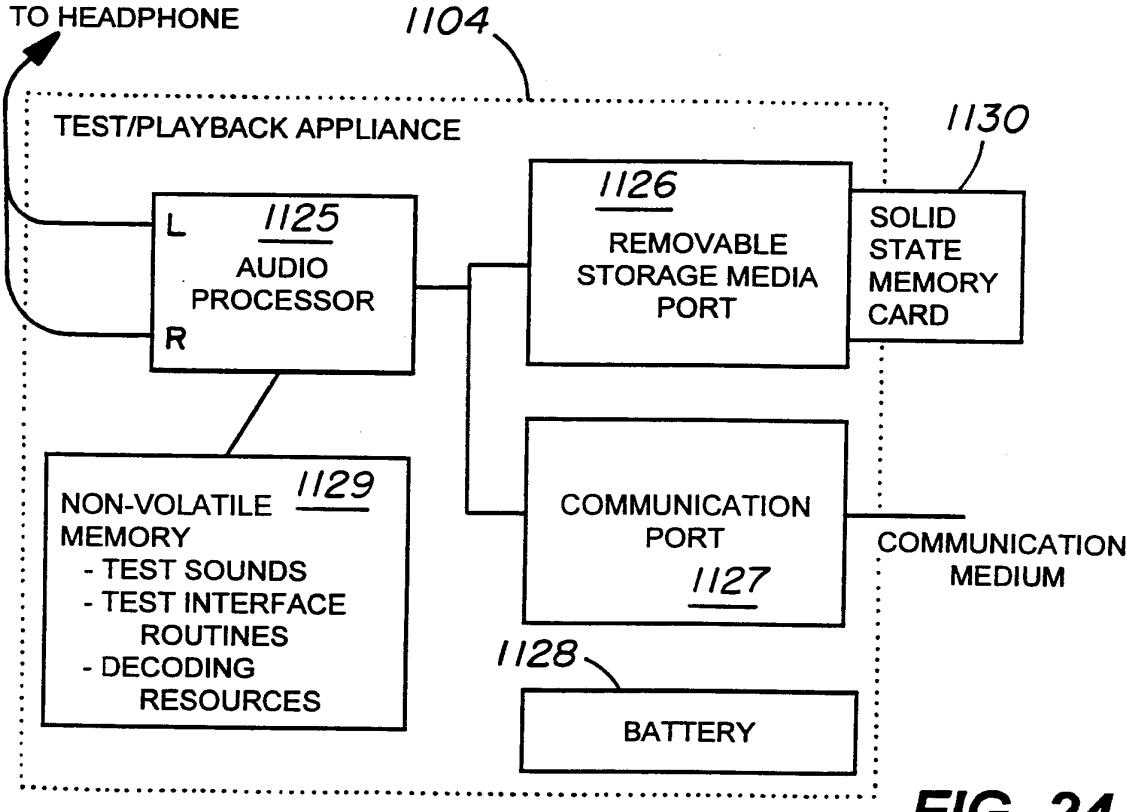

FIG. 24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/26231

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H04R 5/00, 1/10, 5/02
US CL :381/1, 310, 74, 303, 304, 305,

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 381/1, 310, 74, 303, 304, 305,

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

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,371,799 A (LOWE et al) 06 December 1994, figs. 3-11.	1-188
Y	US 5,854,843 A (JACKNIN et al) 29 December 1998, fig. 1.	1-188
Y	US 5,495,534 A (INANAGA et al) 27 February 1996, figs. 1-6.	1-188
Y	US 5,452,359 A (INANAGA et al) 19 September 1995, figs. 1-6.	1-188

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search 15 NOVEMBER 2000	Date of mailing of the international search report 26 JAN 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MINSUN OH HARVEY Telephone No. (703) 308-6741

Form PCT/ISA/210 (second sheet) (July 1998)★

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: HOWELL et al.

Attorney Docket No.: IPVCP003C10

Application No.: 17/873,104

Examiner: LEI, JIE

Filed: July 25, 2022

Group: 2872

Title: WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT

AMENDMENT C TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith is an Amendment in the above-identified application.

The fee has been calculated as shown below.

	Claims After Amendment		Highest Previously Paid For	Present Extra	Small Entity Rate Fee	Large Entity Rate Fee
Total Claims	76	MINUS	20	56	x 40 =	x 100 = 5,600
Independent Claims	3	MINUS	3	00	x 192 =	x 480 =
Multiple Dependent Claim Present and Fee Not Previously Paid					$	$
				Total	$0.00	$5,600

☐ Applicant(s) hereby petition for a _____- month extension(s) of time to respond to the aforementioned Office Action.

☒ Applicant(s) believe that no (additional) Extension of Time is required; however, if it is determined that such an extension is required, Applicant(s) hereby petition that such an extension be granted and authorize the Commissioner to charge the required fees for an Extension of Time under 37 CFR 1.136 to Deposit Account No. 50-3874 (Order No. IPVCP003C10).

☒ Any fees due are being paid electronically herewith.

☒ Please charge any additional fees required to facilitate filing the enclosed response, to Deposit Account No. 50-3874 (Order No. IPVCP003C10).

Respectfully submitted,

/C. Douglass Thomas/

C. Douglass Thomas
Reg. No. 32,947

Electronic Patent Application Fee Transmittal

Application Number:	17873104
Filing Date:	25-Jul-2022
Title of Invention:	WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT
First Named Inventor/Applicant Name:	Thomas A. Howell
Filer:	Peter P. Tong/Angela Nijim
Attorney Docket Number:	IPVCP003C10

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	56	100	5600
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1360	1360
		Total in USD ($)		**6960**

Electronic Acknowledgement Receipt	
EFS ID:	47633287
Application Number:	17873104
International Application Number:	
Confirmation Number:	2978
Title of Invention:	WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT
First Named Inventor/Applicant Name:	Thomas A. Howell
Customer Number:	34071
Filer:	Peter P. Tong/Angela Nijim
Filer Authorized By:	Peter P. Tong
Attorney Docket Number:	IPVCP003C10
Receipt Date:	06-MAR-2023
Filing Date:	25-JUL-2022
Time Stamp:	19:32:38
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$6960
RAM confirmation Number	E202336J34347200
Deposit Account	503874
Authorized User	Angela Nijim
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	IPVCP003C10_RCE_3-23.pdf	1667134 0930eed350006a5c651e4d20029f1f473888091d	no	3
Warnings:					
Information:					
2	Transmittal Letter	IPVCP003C10_IDSTrans_3-23.pdf	19681 48a0d8a0e1eaadca4e261bbd3c665e0297f75552	no	2
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	IPVCP003C10_1449_3-23.pdf	36120 77b13f20e9971bd6e65dc56669a11db25b2ec265	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	Foreign Reference	EP1027626B1.pdf	227715 9bb88c6e61d9c3f534a294543318b5811c353ff0	no	15
Warnings:					
Information:					
5	Foreign Reference	EP2290433B1.pdf	436060 6037605a64e4053955c41f6e315d12a83eee7ef1	no	24
Warnings:					
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6	Foreign Reference	JP-2002-511706A.pdf	2904875 17231b8d89f40b47b6ba4c762164605d5758a30f	no	44
Warnings:					

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7	Foreign Reference	KR-20020044416A_Choi.pdf	3969556 b524031330747d959f93732d39445693c5048287	no	47
Warnings:					
Information:					
8	Foreign Reference	WO0124576A1.pdf	4902952 8bbb8004fca106f3fc795ffa01689caa3268df49	no	66
Warnings:					
Information:					
9	Transmittal Letter	IPVCP003C10_AmdCTrans_3-23.pdf	17541 4d1bb531051701ab4916c3d92aed56737a95b405	no	1
Warnings:					
Information:					
10	Amendment Submitted/Entered with Filing of Continued Prosecution Application (CPA)/Request for Continued Examination(RCE)	IPVCP003C10_AmdC_AsFiled_3_5-23.pdf	84765 495dd727a4e5a1f2d2268caec47723e2b362dcde	no	19
Warnings:					
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11	Fee Worksheet (SB06)	fee-info.pdf	40756 abd8dd60fbc4f4eedf5ace897f5e997f5bc338d6	no	2
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Information:					
		Total Files Size (in bytes):	14307155		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: HOWELL et al.	Attorney Docket No.: IPVCP003C10
Application No.: 17/873,104	Examiner: LEI, JIE
Filed: July 25, 2022	Group: 2872
Title: WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT	

AMENDMENT C

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice of Allowance dated December 16, 2022, please amend the above-identified patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 19 of this paper.

AMENDMENTS TO THE CLAIMS:

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A personal audio system operable to at least generate customized audio output, comprising:

a pair of ear buds, each configured to be placed in an ear of a user; and

a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the stored hearing profile associated with the user at least characterizes hearing impairment regarding the user's ability to hear, the mobile communication device configured to produce audio output signals customized for the user based on at least the stored hearing profile associated with the user such that the customized audio output signals ~~are~~ at least compensate ~~compensated~~ for the hearing impairment regarding the user's ability to hear, the mobile communication device configured to produce the customized audio output signals ~~signal~~ using at least signal amplification, and the mobile communication device configured to transmit the customized audio output signals to the pair of ear buds,

wherein each of the ear buds is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and

wherein each of the ear buds is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.

2. (Original) A personal audio system as recited in claim 1, wherein the mobile communication device is configured to establish the hearing profile for the user.

3. (Previously Presented) A personal audio system as recited in claim 2, wherein the hearing profile for the user is established by the mobile communication

device at least via generating audio tones and outputting such to one or more of the ear buds and receiving a user indication corresponding to the user's ability to hear the generated audio tones.

4. (Previously Presented) A personal audio system as recited in claim 1, wherein the signal amplification is frequency-dependent amplification.

5. (New) A personal audio system as recited in claim 1, wherein each of the earbuds includes a speaker, and

wherein the at least a portion of the customized audio output being generated by each of the ear buds is generated by the corresponding speaker.

6. (New) A personal audio system as recited in claim 1, wherein at least one of the earbuds in the pair of earbuds comprises an array of microphones configured for directional audio pickup.

7. (New) A personal audio system as recited in claim 6, wherein direction of the directional audio pickup is in front of the user.

8. (New) A personal audio system as recited in claim 6, wherein direction of the directional audio pickup is outward from the user.

9. (New) A personal audio system as recited in claim 1, wherein at least one of the earbuds in the pair of earbuds comprises a plurality of microphones configured for audio pickup.

10. (New) A personal audio system as recited in claim 9, wherein the plurality of microphones includes at least:

a first microphone configured to receive audio pickup from the user; and

a second microphone configured to receive audio pickup outward away from the user.

11. (New) A personal audio system as recited in claim 10, wherein the audio pickup from at least the second microphone is used at least for noise cancelation.

12. (New) A personal audio system as recited in claim 11, wherein at least a portion of the audio pickup from the second microphone is subtracted from the audio pickup from the first microphone.

13. (New) A personal audio system as recited in claim 12, wherein each of the ear buds includes at least a speaker and is configured to generate at least a portion of the customized audio output for the user via the speaker.

14. (New) A personal audio system as recited in claim 1, wherein the mobile communication device is or includes a mobile phone.

15. (New) A personal audio system as recited in claim 1, wherein the customized audio output includes music.

16. (New) A personal audio system as recited in claim 1, wherein the customized audio output includes a voice conversation.

17. (New) A personal audio system as recited in claim 1,

wherein at least one of the earbuds in the pair of earbuds comprises a plurality of microphones configured for audio pickup,

wherein at least one of the microphones is configured to pick up an audio command, and

wherein the mobile communication device is configured to induce an operation or action based on the audio command.

18. (New) A personal audio system as recited in claim 1, wherein the customized audio output signals are produced based on amplifying or attenuating different frequency bands differently according to at least the stored hearing profile.

19. (New) A personal audio system as recited in claim 1, wherein the hearing profile associated with the user is self-determined by the user.

20. (New) A personal audio system as recited in claim 1,

wherein the mobile communication device includes computing capabilities and a storage device, the storage device storing at least a software program executed by the mobile communication device to enable the user to establish the hearing profile associated with the user, and

wherein the mobile communication device is configured to establish the hearing profile associated with the user via the software program executed by the mobile communication device based on the user interacting with the software program via the mobile communication device.

21 (New) A personal audio system as recited in claim 20, wherein the software program at least interactively guides the user to establish the hearing profile for the user.

22. (New) A personal audio system as recited in claim 21, wherein the software program at least interactively guides the user to establish the hearing profile for the user by at least causing various audio tones to be output to the user via at least one of the earbuds, prompting the user to provide a hearing input with respect to one or more of the various audio tones being output, and receiving the hearing user input pertaining to one or more of the various audio tones being output.

23. (New) A personal audio system as recited in claim 1,

wherein at least one of the earbuds in the pair of earbuds comprises

a radiation detector configured to capture radiation data; and

first electronic circuitry electrically connected to the radiation detector, the first electronic circuitry configured to process at least the radiation data captured by the radiation detector,

wherein the first electronic circuitry is configured to determine whether the earbud is being worn by a user based on at least the processed radiation data.

24. (New) A personal audio system operable to at least generate customized audio output, comprising:

a head-worn wearable electronic device including at least a pair of speakers, each of the speakers being configured to be wearable proximate to an ear of a user; and

a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing profile associated with the user, the stored hearing profile associated with the user at least characterizes hearing impairment regarding the user's ability to hear, the mobile communication device configured to produce audio output signals customized for the user based on at least the stored hearing profile associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear, the mobile communication device configured to produce the customized audio output signals using at least signal amplification, and the mobile communication device configured to transmit the customized audio output signals to the pair of speakers,

wherein each of the speakers is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and

wherein each of the speakers is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.

25. (New) A personal audio system as recited in claim 24,

wherein the head-worn wearable electronic device includes at least a rechargeable battery, and

wherein the rechargeable battery is able to be charged when the head-worn wearable electronic device is coupled to a docking station.

26. (New) A personal audio system as recited in claim 24,

wherein the head-worn wearable electronic device includes at least a rechargeable battery and at least one conductive element,

wherein the rechargeable battery is able to be electrically coupled via the at least one conductive element to a charging apparatus and charged when the head-worn wearable electronic device is placed within the charging apparatus, and

wherein the electrical coupling of the at least one conductive element with the charging apparatus is supported by at least a magnetic element.

27. (New) A personal audio system as recited in claim 24, wherein the mobile communication device is configured to wirelessly communicate with the head-worn wearable electronic device over a wireless network.

28. (New) A personal audio system as recited in claim 27, wherein the wireless network is a short-range wireless network.

29. (New) A personal audio system as recited in claim 27, wherein the short-range wireless network is a Bluetooth network.

30. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device includes an accelerometer.

31. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device includes a plurality of circuit boards, each circuit board including at least one integrated circuit mounted thereto.

32. (New) A personal audio system as recited in claim 31, wherein at least one of the circuit boards is a flexible printed circuit board.

33. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device includes a touch sensitive surface.

34. (New) A personal audio system as recited in claim 33, wherein the touch sensitive surface is configured to detect a user input, the detected user input operating to at least alter operation of the head-worn wearable electronic device.

35. (New) A personal audio system as recited in claim 34, wherein the head-worn wearable electronic device is configured to support audio output to the user, and

wherein the at least one operation of the head-worn electronic device being altered concerns control of the audio output being provided to the user.

36. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device includes a force sensor configured to receive a user input based at least on sensing force applied to the force sensor.

37. (New) A personal audio system as recited in claim 36, wherein the force sensor is configured to detect the user input, the detected user input operating to alter at least an operation of the head-worn wearable electronic device.

38. (New) A personal audio system as recited in claim 37, wherein the head-worn wearable electronic device is configured to support audio output to the user, and

wherein the at least one operation of the head-worn electronic device being altered concerns control of the audio output being provided to the user.

39. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device comprises a switch, the switch being configured to be activated by a mechanical force.

40. (New) A personal audio system as recited in claim 39, wherein the switch is configured to detect a user input based on the mechanical force, the detected user input operating to at least alter operation of the head-worn wearable electronic device.

41. (New) A personal audio system as recited in claim 40, wherein the head-worn wearable electronic device is configured to support audio output to the user, and

wherein the at least one operation of the head-worn electronic device being altered concerns control of the audio output being provided to the user.

42. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device comprises:

a first head-worn structure including at least a first speaker of the pair of speakers, the first speaker being wearable proximate to a first ear of the user; and

a second head-worn structure including at least a second speaker of the pair of speakers, the second speaker being wearable proximate to a second ear of the user.

43. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure comprises:

a first circuit board internal to the first head-worn structure, the first circuit board supporting at least a first integrated circuit and a second integrated circuit, the first integrated circuit and the second integrated circuit being physically attached to the first circuit board, and the first integrated circuit being electrically connected to the second integrated circuit or another electronic component.

44. (New) A personal audio system as recited in claim 43, wherein the first circuit board is a flexible circuit board.

45. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure comprises:

a user input device, the user input device being configured to receive a user input, the user input device is based on at least capacitive effect, wherein the user input being received induces at least a capacitive change to produce at least an electrical response.

46. (New) A personal audio system as recited in claim 45, wherein the user input device is configured to distinguish at least a direction of the user input with respect to the user input device.

47. (New) A personal audio system as recited in claim 46, wherein the user input device is configured to detect at least a sliding of a finger action with respect to the user input device.

48. (New) A personal audio system as recited in claim 45, wherein the user input device is configured to distinguish at least whether the user input pertains to a forward sliding action or a backward sliding action with respect to the user input device.

49. (New) A personal audio system as recited in claim 48, wherein the head-worn wearable electronic device comprises:

a second circuit board internal to the second head-worn structure, the second circuit board supporting at least a third integrated circuit and a fourth integrated circuit, the third integrated circuit and the fourth integrated circuit being physically attached to the second circuit board, and the third integrated circuit being electrically connected to the fourth integrated circuit or another electronic component.

50. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure of the head-worn wearable electronic device comprises:

a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the first head-worn structure and is positioned to be directed towards the user when the first head-worn structure is being worn by the user; and

a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the first head-worn structure, the

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second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user.

51. (New) A personal audio system as recited in claim 42,

wherein the first head-worn structure comprises:

a first circuit board internal to the first head-worn structure, the first circuit board supporting at least a first integrated circuit, the first integrated circuit being physically attached to the first circuit board,

wherein the first integrated circuit includes at least a processing unit, and

wherein the processing unit is configured to:

determine an ambient sound level; and

amplify audio output from the first speaker dependent at least in part on the ambient sound level.

52. (New) A personal audio system as recited in claim 42,

wherein the first head-worn structure of the wearable electronic device comprises:

a battery internal to the first head-worn structure; and

at least one conductive element that facilitates electrical coupling with the battery, the at least one conductive element is at least partially internal to the first head-worn structure but remains at least partially exposed external to the first head-worn structure, and the at least one conductive element comprises at least one conductive pad,

wherein the battery is able to be electrically coupled via the at least one conductive element to a charging apparatus and charged when at least the first head-worn structure of the head-worn wearable electronic device is placed within the charging apparatus, and

wherein the electrical coupling of the at least one conductive element with the charging apparatus is supported by at least a magnetic element.

53. (New) A personal audio system as recited in claim 52, wherein the head-worn wearable electronic device comprises:

a microphone at least partially internal to the first head-worn structure,

wherein the head-worn wearable electronic device is configured to receive a voice input via the microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn wearable electronic device based on the requested operation.

54. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure comprises:

an infrared emitter configured to at least direct infrared signals towards the user when at least the first head-worn structure of the head-worn wearable electronic device is being worn; and

an infrared detector configured to detect infrared radiation reflected back from the user when at least the first head-worn structure of the head-worn wearable electronic device is being worn.

55. (New) A personal audio system as recited in claim 54, wherein electronic circuitry within the first head-worn structure is configured to facilitate determining whether the first head-worn structure is being worn by the user based on at least the detected infrared radiation.

56. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure comprises:

a radiation detector configured to capture radiation data; and

first electronic circuitry provided within the first head-worn structure and electrically connected to the radiation detector, the first electronic circuitry configured to process at least the radiation data captured by the radiation detector.

57. (New) A personal audio system as recited in claim 56, wherein the first electronic circuitry is configured to determine whether the first head-worn structure is being worn by a user based on at least the processed radiation data.

58. (New) A personal audio system as recited in claim 57, wherein the radiation detector comprises a photodetector.

59. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure comprises first electronic circuitry configured to provide audio alerts to the user via the first speaker.

60. (New) A personal audio system as recited in claim 59, wherein the audio alerts are dependent on one or more user preference settings.

61. (New) A personal audio system as recited in claim 42,

wherein the first head-worn structure of the head-worn wearable electronic device comprises:

a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the first head-worn structure; and

a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the first head-worn structure,

wherein the second microphone is positioned to be further away from mouth of the user than the first microphone when at least the first head-worn structure of the head-worn wearable electronic device is being worn.

62. (New) A personal audio system as recited in claim 42, wherein the first head-worn structure comprises:

a physical condition sensor configured to acquire data pertaining to a physical condition of the user, the physical condition sensor being provided at least partially internal to the first head-worn structure.

63. (New) A personal audio system as recited in claim 62, wherein the acquired data by the physical condition sensor includes data pertaining to or dependent on heart beats of the user.

64. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device comprises:

a head-worn structure including at least a first microphone, a second microphone, a speaker and a processing unit;

wherein the first microphone is configured to pick up at least audio input from at least the user,

wherein the second microphone is configured to pick up at least environmental audio input associated with an environment in the vicinity of the head-worn wearable electronic device, and

wherein the processing unit is configured to process the audio input from at least the user via the first microphone to remove at least a portion of the environmental audio input associated with the environment picked up via the second microphone.

65. (New) A personal audio system as recited in claim 64,

wherein the audio input from at least the user picked-up via the first microphone includes at least a voice input, and

wherein the environmental audio input associated with the environment includes at least ambient noise.

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66. (New) A personal audio system as recited in claim 64, wherein the processing unit is configured to process the audio input from at least the user picked-up via the first microphone to remove at least a portion of the environmental audio input picked-up via the second microphone.

67. (New) A personal audio system as recited in claim 64,

wherein the first microphone is at least partially in the head-worn structure and is positioned so as to be directed towards the user of the head-worn structure, and

wherein the second microphone is at least partially in the head-worn structure so as to be directed away from the user of the head-worn structure.

68. (New) A personal audio system as recited in claim 67, wherein the processing unit is configured to process the audio input picked-up via at least the first microphone to remove at least a portion of the environmental audio input picked-up via the second microphone.

69. (New) A personal audio system as recited in claim 68,

wherein the audio input from at least the user includes at least a voice input, and

wherein the environmental audio input includes at least ambient noise.

70. (New) A personal audio system as recited in claim 24, wherein the head-worn wearable electronic device comprises:

a head-worn structure comprising at least two microphones and a processing unit,

wherein the at least two microphones are configured to pick up (i) at least audio input from at least the user and (ii) at least environmental audio input associated with environmental sound in the vicinity of the head-worn structure, and

wherein the processing unit is configured to:

determine an environmental sound level based on at least the environmental audio input; and

amplify at least a portion of the audio input from the first microphone, with the amplification being at least in part dependent on the environmental sound level.

71. (New) A personal audio system as recited in claim 24,

wherein the head-worn wearable electronic device comprises at least a first microphone, a second microphone and a processing unit,

wherein the first microphone is configured to pick up at least audio sound from at least the user,

wherein the second microphone is configured to pick up at least ambient noise associated with an environment in the vicinity of the head-worn wearable electronic device, and

wherein the processing unit is configured to:

determine an ambient noise level based on at least the ambient noise; and

modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.

72. (New) A personal audio system as recited in claim 24,

wherein the head-worn wearable electronic device comprises at least a first microphone, a second microphone and a processing unit,

wherein the first microphone is configured to pick up at least audio sound from at least the user,

wherein the second microphone is configured to pick up at least ambient noise associated with an environment in the vicinity of the head-worn wearable electronic device,

wherein the processing unit is configured to:

determine an ambient noise level based on at least the ambient noise; and

modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level,

wherein the head-worn wearable electronic device comprises at least a rechargeable battery and at least one conductive element,

wherein the rechargeable battery is able to be electrically coupled via the at least one conductive element to a charging apparatus and charged when the head-worn wearable electronic device is placed within the charging apparatus,

wherein the mobile communication device is configured to wirelessly communicate with the head-worn wearable electronic device over a wireless network, and

wherein the mobile communication device is or includes a mobile phone.

wherein the head-worn wearable electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn wearable electronic device based on the requested operation.

73. (New) A personal audio system as recited in claim 72, wherein the head-worn wearable electronic device comprises:

an infrared emitter configured to at least direct infrared signals towards the user when the head-worn wearable electronic device is being worn;

an infrared detector configured to detect infrared radiation reflected back from the user when the head-worn wearable electronic device is being worn; and

electronic circuitry configured to facilitate determining whether the head-worn wearable electronic device is being worn by the user based on at least the detected infrared radiation.

74. (New) A personal audio system as recited in claim 73, wherein the electrical coupling of the at least one conductive element with the charging apparatus is supported by at least a magnetic element.

75. (New) A personal audio system operable to at least generate customized audio output, comprising:

a pair of speakers, each of the speakers being configured to be wearable proximate to an ear of a user; and

a mobile communication device at least for supporting audio output, the mobile communication device configured to store at least a hearing characteristic associated with the user, the stored hearing characteristic associated with the user at least characterizes hearing impairment regarding the user's ability to hear, the mobile communication device configured to produce customized audio output signals for the user based on at least the stored hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear, the mobile communication device configured to produce the customized audio output signals using at least signal amplification, and the mobile communication device configured to transmit the customized audio output signals to the pair of speakers,

wherein each of the speakers is configured to receive at least a portion of the customized audio output signals transmitted by the mobile communication device, and

wherein each of the speakers is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals being received.

76. (New) A personal audio system as recited in claim 75, wherein each of the speakers being configured to be at least partially inserted into an ear of the user.

REMARKS

Further to the Notice of Allowance, claim 1 has been amended to further clarify the subject matter regarded as the invention. New claims 5-76 have been added to the application. Claims 1-76 are pending. Reconsideration of the application is respectfully requested based on the following remarks.

Reconsideration of the application and an early Notice of Allowance are earnestly solicited.

Applicant hereby petitions for an extension of time which may be required to maintain the pendency of this case, and any required fee for such extension or any further fee required in connection with the filing of this Amendment is to be charged to Deposit Account No. 50-3874 (Order No. IPVCP003C10).

Respectfully submitted,

/C. Douglass Thomas/

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Reg. No. 32,947

(650) 903-9200, x103

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/873,104	Howell et al.
	Examiner	**Art Unit**
	JIE LEI	2872

CPC							
Symbol						**Type**	**Version**
G02C	/	11	/	10		F	2013-01-01
G02C	/	5	/	001		I	2013-01-01
G02C	/	11	/	06		I	2013-01-01
G02C	/	5	/	14		I	2013-01-01

CPC Combination Sets								
Symbol						**Type**	**Set**	**Ranking**	**Version**
	/		/						

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	76	
/JIE LEI/ Primary Examiner, Art Unit 2872	09 March 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230309

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/873,104	Howell et al.
	Examiner	**Art Unit**
	JIE LEI	2872

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G02C	/	11	/	00
G02C	/	5	/	00
G02C	/	11	/	06
G02C	/	5	/	14

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
351	158

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 76	
/JIE LEI/ Primary Examiner, Art Unit 2872 (Primary Examiner)	09 March 2023 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office

Part of Paper No.: 20230309

Apple Inc. Exhibit 1002 Page 1226

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/873,104	Howell et al.
	Examiner	**Art Unit**
	JIE LEI	2872

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		11		21		31		41		51		61		71
	2		12		22		32		42		52		62		72
	3		13		23		33		43		53		63		73
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	5		15		25		35		45		55		65		75
	6		16		26		36		46		56		66		76
	7		17		27		37		47		57		67		
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	9		19		29		39		49		59		69		
	10		20		30		40		50		60		70		

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	76	
/JIE LEI/ Primary Examiner, Art Unit 2872	09 March 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230309

Apple Inc. Exhibit 1002 Page 1227

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/873,104	Howell et al.
	Examiner	Art Unit
	JIE LEI	2872

CPC - Searched*		
Symbol	**Date**	**Examiner**
G02C 1/00, 11/10, 11/06, 5/001, 5/02, 5/14, 5/22, 5/146	09/27/2022	JL
G02B 27/01, 27/017, 27/0176	09/27/2022	JL
update search	10/27/2022	JL
update search	12/06/2022	JL
update search	03/09/2023	JL

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
351	158, 41, 111, 121,123,124	09/27/2022	JL
359	13, 629-633	09/27/2022	JL
381	381, 327, 328, 370, 380	09/27/2022	JL
	update search	10/27/2022	JL
	update search	12/06/2022	JL
	update search	03/09/2023	JL

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

/JIE LEI/ Primary Examiner, Art Unit 2872	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/873,104	Howell et al.
	Examiner	Art Unit
	JIE LEI	2872

Search Notes		
Search Notes	**Date**	**Examiner**
G02C 1/00, 11/10, 11/06, 5/001, 5/02, 5/14, 5/22, 5/146 class and text search	09/27/2022	JL
G02B 27/01, 27/017, 27/0176 class and text search	09/27/2022	JL
351/158, 41, 111, 121,123,124 class and text search	09/27/2022	JL
359/13, 629-633 class and text search	09/27/2022	JL
381/381, 327, 328, 370, 380 class and text search	09/27/2022	JL
Inventor name search	09/27/2022	JL
NPL and foreign search (google scholar, google patent, globaldossier and Dialog search)	09/27/2022	JL
PE2E text search	09/27/2022	JL
update search	10/27/2022	JL
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Similarity search	12/06/2022	JL
update search	03/09/2023	JL

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	USPGPUB, USPAT	09/27/2022	JL
	update search	10/27/2022	JL
	update search	12/06/2022	JL
	update search	03/09/2023	JL

/JIE LEI/ Primary Examiner, Art Unit 2872	

Bibliographic Data

Application No: 17/873,104

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /JIE LEI/ (Examiner's Signature) | (Initials)

Title: WEARABLE AUDIO SYSTEM SUPPORTING ENHANCED HEARING SUPPORT

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/25/2022	351	2872	IPVCP003C10
RULE			

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CONTINUING DATA

This application is a CON of 17484080 09/24/2021

17484080 is a CON of 16574254 09/18/2019 PAT 11204512

16574254 is a CON of 16049120 07/30/2018 PAT 11243416

16049120 is a CON of 15375423 12/12/2016 PAT 10061144

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11183269 has PRO of 60647836 01/31/2005

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11183269 has PRO of 60592045 07/28/2004

FOREIGN APPLICATIONS

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STATE OR COUNTRY

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$3,080

Web Search History

date, time	web site	search string
3/8/2023 3:50:02 PM	Google Patents	Search Term 1 (Audio sunglasses)
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3/8/2023 4:24:36 PM	Google Scholar	temperature sensor btt tunnel thermal
3/8/2023 4:24:36 PM	Google Patents	Search Term 1 temperature Search Term 2 sensor Search Term 3 btt Search Term 4 tunnel Search Term 5 thermal Before Priority Date: priority:20030422
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3/8/2023 4:34:31 PM	Google Scholar	temple eyewear recited eyeglass frame electrical components
3/8/2023 4:34:31 PM	Google Patents	Search Term 1 temple Search Term 2 eyewear Search Term 3 recited Search Term 4 eyeglass frame Search Term 5 electrical components Before Priority Date: priority:20031009
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3/8/2023 4:34:40 PM	Google Patents	Search Term 1 eyeglasses Search Term 2 sensor Search Term 3 wireless communication Search Term 4 recited Search Term 5 communication circuitry Before Priority Date: priority:20030415
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3/8/2023 4:34:47 PM	Google Patents	Search Term 1 (glasses) (audio signals) (user) (frame) (hearing) Before Priority Date: priority:20031009
3/8/2023 4:34:48 PM	Google Scholar	glasses audio signals user frame hearing
3/8/2023 4:34:48 PM	Google Patents	Search Term 1 glasses Search Term 2 audio signals Search Term 3 user Search Term 4 frame Search Term 5 hearing Before Priority Date: priority:20031009
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3/8/2023 4:35:00 PM	Google Patents	Search Term 1 glasses Search Term 2 pair Search Term 3 information Search Term 4 recited Search Term 5 event Before Priority Date: priority:20031009
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3/8/2023 4:35:07 PM	Google Patents	Search Term 1 (temple) (glasses) (pair) (connector) (electrical components) Before Priority Date: priority:20031009
3/8/2023 4:35:08 PM	Google Scholar	temple glasses pair connector electrical components
3/8/2023 4:35:08 PM	Google Patents	Search Term 1 temple Search Term 2 glasses Search Term 3 pair Search Term 4 connector Search Term 5 electrical components Before Priority Date: priority:20031009
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3/8/2023 4:35:16 PM	Google Patents	Search Term 1 glasses Search Term 2 pair Search Term 3 pedometer Search Term 4 temple Search Term 5 recited Before Priority Date: priority:20031009
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3/8/2023 4:35:23 PM	Google Patents	Search Term 1 (glasses) (eyeglass frame) (temple) (user) (connector) Before Priority Date: priority:20031009
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3/8/2023 4:35:24 PM	Google Patents	Search Term 1 glasses Search Term 2 eyeglass frame Search Term 3 temple Search Term 4 user Search Term 5 connector Before Priority Date: priority:20031009
3/8/2023 4:49:57 PM	Google Scholar	(glasses) (camera) (pair) (temple) (user)

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3/8/2023 4:49:58 PM	Google Patents	Search Term 1 glasses Search Term 2 camera Search Term 3 pair Search Term 4 temple Search Term 5 user Before Priority Date: priority:20031009
3/8/2023 4:50:09 PM	Google Scholar	(temple) (connector) (rearward) (recited) (electrical components)
3/8/2023 4:50:09 PM	Google Patents	Search Term 1 (temple) (connector) (rearward) (recited) (electrical components) Before Priority Date: priority:20030415
3/8/2023 4:50:11 PM	Google Scholar	temple connector rearward recited electrical components
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3/8/2023 4:50:18 PM	Google Scholar	(glasses) (clock) (temperature) (pair) (temperature sensor)

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date, time	web site	search string
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3/8/2023 4:50:19 PM	Google Scholar	glasses clock temperature pair temperature sensor
3/8/2023 4:50:19 PM	Google Patents	Search Term 1 glasses Search Term 2 clock Search Term 3 temperature Search Term 4 pair Search Term 5 temperature sensor Before Priority Date: priority:20031009
3/8/2023 4:50:26 PM	Google Scholar	(eyewear) (user) (frame) (glasses) (touch sensitive)
3/8/2023 4:50:26 PM	Google Patents	Search Term 1 (eyewear) (user) (frame) (glasses) (touch sensitive) Before Priority Date: priority:20031009
3/8/2023 4:50:27 PM	Google Scholar	eyewear user frame glasses touch sensitive
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date, time	web site	search string
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3/8/2023 4:50:36 PM	Google Patents	Search Term 1 eyewear frame Search Term 2 recited Search Term 3 user Search Term 4 glasses Search Term 5 electrical Before Priority Date: priority:20031009
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3/8/2023 5:09:49 PM	Google Scholar	electro intraocular active lens eye
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3/8/2023 5:10:08 PM	Google Scholar	audio device audio personal electronic soft audio signal
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3/8/2023 5:10:31 PM	Google Patents	Search Term 1 frame Search Term 2 module Search Term 3 electro Search Term 4 switch Search Term 5 electronic Before Priority Date: priority:20070504
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date, time	web site	search string
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3/8/2023 5:10:52 PM	Google Scholar	(hinge) (temple) (frame) (utep) (electrical)
3/8/2023 5:10:52 PM	Google Patents	Search Term 1 (hinge) (temple) (frame) (utep) (electrical) Before Priority Date: priority:20061027
3/8/2023 5:10:54 PM	Google Scholar	hinge temple frame utep electrical

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date, time	web site	search string
3/8/2023 5:10:54 PM	Google Patents	Search Term 1 hinge Search Term 2 temple Search Term 3 frame Search Term 4 utep Search Term 5 electrical Before Priority Date: priority:20061027
3/8/2023 5:11:13 PM	Google Scholar	(optical) (optical element) (adjustable) (adjustable connector) (wearer)
3/8/2023 5:11:13 PM	Google Patents	Search Term 1 (optical) (optical element) (adjustable) (adjustable connector) (wearer) Before Priority Date: priority:20061214
3/8/2023 5:11:15 PM	Google Scholar	optical optical element adjustable adjustable connector wearer
3/8/2023 5:11:15 PM	Google Patents	Search Term 1 optical Search Term 2 optical element Search Term 3 adjustable Search Term 4 adjustable connector Search Term 5 wearer Before Priority Date: priority:20061214
3/8/2023 5:32:51 PM	Google Scholar	(lens) (housing) (module) (temple) (frame)
3/8/2023 5:32:51 PM	Google Patents	Search Term 1 (lens) (housing) (module) (temple) (frame) Before Priority Date: priority:20100702
3/8/2023 5:32:54 PM	Google Scholar	lens housing module temple frame

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date, time	web site	search string
3/8/2023 5:32:54 PM	Google Patents	Search Term 1 lens Search Term 2 housing Search Term 3 module Search Term 4 temple Search Term 5 frame Before Priority Date: priority:20100702
3/8/2023 5:33:00 PM	Google Scholar	(electro) (active) (temple) (frame) (spectacles)
3/8/2023 5:33:00 PM	Google Patents	Search Term 1 (electro) (active) (temple) (frame) (spectacles) Before Priority Date: priority:20070504
3/8/2023 5:33:02 PM	Google Scholar	electro active temple frame spectacles
3/8/2023 5:33:02 PM	Google Patents	Search Term 1 electro Search Term 2 active Search Term 3 temple Search Term 4 frame Search Term 5 spectacles Before Priority Date: priority:20070504
3/8/2023 5:33:08 PM	Google Scholar	(lens) (housing) (lens housing) (temple) (module)
3/8/2023 5:33:08 PM	Google Patents	Search Term 1 (lens) (housing) (lens housing) (temple) (module) Before Priority Date: priority:20100702
3/8/2023 5:33:09 PM	Google Scholar	lens housing lens housing temple module

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date, time	web site	search string
3/8/2023 5:33:09 PM	Google Patents	Search Term 1 lens Search Term 2 housing Search Term 3 lens housing Search Term 4 temple Search Term 5 module Before Priority Date: priority:20100702
3/8/2023 5:33:16 PM	Google Scholar	(temple) (electronics module) (electrical) (electrical conductor) (touch switch)
3/8/2023 5:33:16 PM	Google Patents	Search Term 1 (temple) (electronics module) (electrical) (electrical conductor) (touch switch) Before Priority Date: priority:20110211
3/8/2023 5:33:18 PM	Google Scholar	temple electronics module electrical electrical conductor touch switch
3/8/2023 5:33:18 PM	Google Patents	Search Term 1 temple Search Term 2 electronics module Search Term 3 electrical Search Term 4 electrical conductor Search Term 5 touch switch Before Priority Date: priority:20110211
3/8/2023 5:33:41 PM	Google Scholar	(electro) (eyewear) (electronic) (active) (frame)
3/8/2023 5:33:41 PM	Google Patents	Search Term 1 (electro) (eyewear) (electronic) (active) (frame) Before Priority Date: priority:20070504
3/8/2023 5:33:42 PM	Google Scholar	electro eyewear electronic active frame

date, time	web site	search string
3/8/2023 5:33:42 PM	Google Patents	**Search Term 1** electro **Search Term 2** eyewear **Search Term 3** electronic **Search Term 4** active **Search Term 5** frame **Before** Priority Date: priority:20070504
3/8/2023 5:33:48 PM	Google Scholar	(lens) (lens housing) (conductive element) (compliant) (temple)
3/8/2023 5:33:48 PM	Google Patents	**Search Term 1** (lens) (lens housing) (conductive element) (compliant) (temple) **Before** Priority Date: priority:20100702
3/8/2023 5:33:50 PM	Google Scholar	lens lens housing conductive element compliant temple
3/8/2023 5:33:50 PM	Google Patents	**Search Term 1** lens **Search Term 2** lens housing **Search Term 3** conductive element **Search Term 4** compliant **Search Term 5** temple **Before** Priority Date: priority:20100702
3/8/2023 5:33:56 PM	Google Scholar	(ultraviolet) (exposure time) (environmental conditions) (information) (ultraviolet exposure)
3/8/2023 5:33:56 PM	Google Patents	**Search Term 1** (ultraviolet) (exposure time) (environmental conditions) (information) (ultraviolet exposure) **Before** Priority Date: priority:20071128

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date, time	web site	search string
3/8/2023 5:33:57 PM	Google Scholar	ultraviolet exposure time environmental conditions information ultraviolet exposure
3/8/2023 5:33:57 PM	Google Patents	Search Term 1 ultraviolet Search Term 2 exposure time Search Term 3 environmental conditions Search Term 4 information Search Term 5 ultraviolet exposure Before Priority Date: priority:20071128
3/8/2023 5:34:03 PM	Google Scholar	(local) (sensor) (coupled) (exposure) (conditions)
3/8/2023 5:34:03 PM	Google Patents	Search Term 1 (local) (sensor) (coupled) (exposure) (conditions) Before Priority Date: priority:20071128
3/8/2023 5:34:04 PM	Google Scholar	local sensor coupled exposure conditions
3/8/2023 5:34:04 PM	Google Patents	Search Term 1 local Search Term 2 sensor Search Term 3 coupled Search Term 4 exposure Search Term 5 conditions Before Priority Date: priority:20071128
3/8/2023 5:44:07 PM	Google Scholar	(hwc) (ear horn) (section) (temple) (head)
3/8/2023 5:44:07 PM	Google Patents	Search Term 1 (hwc) (ear horn) (section) (temple) (head) Before Priority Date: priority:20140425

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date, time	web site	search string
3/8/2023 5:44:09 PM	Google Scholar	hwc ear horn section temple head
3/8/2023 5:44:09 PM	Google Patents	Search Term 1 hwc Search Term 2 ear horn Search Term 3 section Search Term 4 temple Search Term 5 head Before Priority Date: priority:20140425
3/8/2023 5:44:35 PM	Google Scholar	(eyewear) (speaker) (eyewear frame) (cord) (frame)
3/8/2023 5:44:35 PM	Google Patents	Search Term 1 (eyewear) (speaker) (eyewear frame) (cord) (frame) Before Priority Date: priority:20080825
3/8/2023 5:44:36 PM	Google Scholar	eyewear speaker eyewear frame cord frame
3/8/2023 5:44:36 PM	Google Patents	Search Term 1 eyewear Search Term 2 speaker Search Term 3 eyewear frame Search Term 4 cord Search Term 5 frame Before Priority Date: priority:20080825
3/8/2023 5:44:46 PM	Google Scholar	(head) (portable electronic) (electronic device) (user) (mounted device)
3/8/2023 5:44:46 PM	Google Patents	Search Term 1 (head) (portable electronic) (electronic device) (user) (mounted device) Before Priority Date: priority:20080930

date, time	web site	search string
3/8/2023 5:44:47 PM	Google Scholar	head portable electronic electronic device user mounted device
3/8/2023 5:44:47 PM	Google Patents	Search Term 1 head Search Term 2 portable electronic Search Term 3 electronic device Search Term 4 user Search Term 5 mounted device Before Priority Date: priority:20080930
3/8/2023 5:44:57 PM	Google Scholar	(light) (hwc) (image) (user) (eye)
3/8/2023 5:44:57 PM	Google Patents	Search Term 1 (light) (hwc) (image) (user) (eye) Before Priority Date: priority:20140121
3/8/2023 5:44:59 PM	Google Scholar	light hwc image user eye
3/8/2023 5:44:59 PM	Google Patents	Search Term 1 light Search Term 2 hwc Search Term 3 image Search Term 4 user Search Term 5 eye Before Priority Date: priority:20140121
3/8/2023 5:45:07 PM	Google Scholar	(light) (eye) (hwc) (user) (wearer)
3/8/2023 5:45:07 PM	Google Patents	Search Term 1 (light) (eye) (hwc) (user) (wearer) Before Priority Date: priority:20081216

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date, time	web site	search string
3/8/2023 5:45:09 PM	Google Scholar	light eye hwc user wearer
3/8/2023 5:45:09 PM	Google Patents	Search Term 1 light Search Term 2 eye Search Term 3 hwc Search Term 4 user Search Term 5 wearer Before Priority Date: priority:20081216
3/8/2023 5:45:19 PM	Google Scholar	(light) (eye) (hwc) (image) (wearer)
3/8/2023 5:45:19 PM	Google Patents	Search Term 1 (light) (eye) (hwc) (image) (wearer) Before Priority Date: priority:20140121
3/8/2023 5:45:20 PM	Google Scholar	light eye hwc image wearer
3/8/2023 5:45:20 PM	Google Patents	Search Term 1 light Search Term 2 eye Search Term 3 hwc Search Term 4 image Search Term 5 wearer Before Priority Date: priority:20140121
3/8/2023 5:45:34 PM	Google Scholar	(electroactive) (glasses) (lens) (frame) (conductive)
3/8/2023 5:45:34 PM	Google Patents	Search Term 1 (electroactive) (glasses) (lens) (frame) (conductive) Before Priority Date: priority:20090109

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date, time	web site	search string
3/8/2023 5:45:36 PM	Google Scholar	electroactive glasses lens frame conductive
3/8/2023 5:45:36 PM	Google Patents	Search Term 1 electroactive Search Term 2 glasses Search Term 3 lens Search Term 4 frame Search Term 5 conductive Before Priority Date: priority:20090109
3/8/2023 5:45:44 PM	Google Scholar	(brightness) (display) (eyepiece) (light) (optical)
3/8/2023 5:45:44 PM	Google Patents	Search Term 1 (brightness) (display) (eyepiece) (light) (optical) Before Priority Date: priority:20100228
3/8/2023 5:45:46 PM	Google Scholar	brightness display eyepiece light optical
3/8/2023 5:45:46 PM	Google Patents	Search Term 1 brightness Search Term 2 display Search Term 3 eyepiece Search Term 4 light Search Term 5 optical Before Priority Date: priority:20100228
3/8/2023 5:46:08 PM	Google Scholar	(eyepiece) (user) (light) (optical) (camera)
3/8/2023 5:46:08 PM	Google Patents	Search Term 1 (eyepiece) (user) (light) (optical) (camera) Before Priority Date: priority:20100228

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date, time	web site	search string
3/8/2023 5:46:10 PM	Google Scholar	eyepiece user light optical camera
3/8/2023 5:46:10 PM	Google Patents	Search Term 1 eyepiece Search Term 2 user Search Term 3 light Search Term 4 optical Search Term 5 camera Before Priority Date: priority:20100228
3/8/2023 5:46:23 PM	Google Scholar	(eyepiece) (user) (image) (lens) (content)
3/8/2023 5:46:23 PM	Google Patents	Search Term 1 (eyepiece) (user) (image) (lens) (content) Before Priority Date: priority:20100228
3/8/2023 5:46:24 PM	Google Scholar	eyepiece user image lens content
3/8/2023 5:46:24 PM	Google Patents	Search Term 1 eyepiece Search Term 2 user Search Term 3 image Search Term 4 lens Search Term 5 content Before Priority Date: priority:20100228

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Web Search History

date, time	web site	search string
3/9/2023 8:06:12 AM	Google Scholar	(eyewear) (temple) (temples) (frame) (transceiver)
3/9/2023 8:06:12 AM	Google Patents	Search Term 1 (eyewear) (temple) (temples) (frame) (transceiver) Before Priority Date: priority:20010430
3/9/2023 8:06:23 AM	Google Scholar	(speaker) (audio device) (audio) (wearable wireless) (wireless audio)
3/9/2023 8:06:23 AM	Google Patents	Search Term 1 (speaker) (audio device) (audio) (wearable wireless) (wireless audio) Before Priority Date: priority:20000602
3/9/2023 8:06:24 AM	Google Scholar	speaker audio device audio wearable wireless wireless audio
3/9/2023 8:06:24 AM	Google Patents	Search Term 1 speaker Search Term 2 audio device Search Term 3 audio Search Term 4 wearable wireless Search Term 5 wireless audio Before Priority Date: priority:20000602
3/9/2023 8:06:34 AM	Google Scholar	(display) (display panel) (housing) (head) (user)
3/9/2023 8:06:34 AM	Google Patents	Search Term 1 (display) (display panel) (housing) (head) (user) Before Priority Date: priority:19931022
3/9/2023 8:06:35 AM	Google Scholar	display display panel housing head user

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date, time	web site	search string
3/9/2023 8:06:35 AM	Google Patents	Search Term 1 display Search Term 2 display panel Search Term 3 housing Search Term 4 head Search Term 5 user Before Priority Date: priority:19931022
3/9/2023 8:06:43 AM	Google Scholar	(eyeglass) (interface system) (camera) (audio) (integrated circuits)
3/9/2023 8:06:44 AM	Google Scholar	eyeglass interface system camera audio integrated circuits
3/9/2023 8:06:44 AM	Google Patents	Search Term 1 eyeglass Search Term 2 interface system Search Term 3 camera Search Term 4 audio Search Term 5 integrated circuits Before Priority Date: priority:19971030
3/9/2023 8:06:47 AM	Google Patents	Search Term 1 (eyewear) Search Term 2 (temple) Search Term 3 (temples) Search Term 4 (frame) Search Term 5 (transceiver) Before Priority Date: priority:20010430
3/9/2023 8:06:49 AM	Google Scholar	eyewear temple temples frame transceiver

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date, time	web site	search string
3/9/2023 8:06:49 AM	Google Patents	Search Term 1 eyewear Search Term 2 temple Search Term 3 temples Search Term 4 frame Search Term 5 transceiver Before Priority Date: priority:20010430
3/9/2023 8:07:23 AM	Google Scholar	(audio) (audio device) (signal) (transceiver) (user)
3/9/2023 8:07:23 AM	Google Patents	Search Term 1 (audio) (audio device) (signal) (transceiver) (user) Before Priority Date: priority:20020726
3/9/2023 8:07:25 AM	Google Scholar	audio audio device signal transceiver user
3/9/2023 8:07:25 AM	Google Patents	Search Term 1 audio Search Term 2 audio device Search Term 3 signal Search Term 4 transceiver Search Term 5 user Before Priority Date: priority:20020726
3/9/2023 8:07:31 AM	Google Scholar	(support) (wearer) (eyeglass) (frame) (audio)
3/9/2023 8:07:31 AM	Google Patents	Search Term 1 (support) (wearer) (eyeglass) (frame) (audio) Before Priority Date: priority:20000602
3/9/2023 8:07:33 AM	Google Scholar	support wearer eyeglass frame audio

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date, time	web site	search string
3/9/2023 8:07:33 AM	Google Patents	Search Term 1 support Search Term 2 wearer Search Term 3 eyeglass Search Term 4 frame Search Term 5 audio Before Priority Date: priority:20000602
3/9/2023 8:07:39 AM	Google Scholar	(eyewear) (frame) (temple) (radio frequency) (frequency transceiver)
3/9/2023 8:07:39 AM	Google Patents	Search Term 1 (eyewear) (frame) (temple) (radio frequency) (frequency transceiver) Before Priority Date: priority:20010430
3/9/2023 8:07:41 AM	Google Scholar	eyewear frame temple radio frequency frequency transceiver
3/9/2023 8:07:41 AM	Google Patents	Search Term 1 eyewear Search Term 2 frame Search Term 3 temple Search Term 4 radio frequency Search Term 5 frequency transceiver Before Priority Date: priority:20010430
3/9/2023 8:07:47 AM	Google Scholar	(cord) (eyeglass) (tethered) (electrical) (recited)
3/9/2023 8:07:47 AM	Google Patents	Search Term 1 (cord) (eyeglass) (tethered) (electrical) (recited) Before Priority Date: priority:20030415
3/9/2023 8:07:48 AM	Google Scholar	cord eyeglass tethered electrical recited

date, time	web site	search string
3/9/2023 8:07:48 AM	Google Patents	Search Term 1 cord Search Term 2 eyeglass Search Term 3 tethered Search Term 4 electrical Search Term 5 recited Before Priority Date: priority:20030415
3/9/2023 8:08:00 AM	Google Scholar	speaker audio device audio support wearable wireless
3/9/2023 8:08:00 AM	Google Patents	Search Term 1 speaker Search Term 2 audio device Search Term 3 audio Search Term 4 support Search Term 5 wearable wireless Before Priority Date: priority:20000602
3/9/2023 8:08:13 AM	Google Scholar	(music) (module) (communication) (temple) (eyeglass)
3/9/2023 8:08:13 AM	Google Patents	Search Term 1 (music) (module) (communication) (temple) (eyeglass) Before Priority Date: priority:20070906
3/9/2023 8:08:15 AM	Google Scholar	music module communication temple eyeglass

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date, time	web site	search string
3/9/2023 8:08:15 AM	Google Patents	Search Term 1 music Search Term 2 module Search Term 3 communication Search Term 4 temple Search Term 5 eyeglass Before Priority Date: priority:20070906
3/9/2023 8:08:20 AM	Google Scholar	(link aggregation) (failure detection) (links) (link) (network)
3/9/2023 8:08:20 AM	Google Patents	Search Term 1 (link aggregation) (failure detection) (links) (link) (network) Before Priority Date: priority:20070906
3/9/2023 8:08:22 AM	Google Scholar	link aggregation failure detection links link network
3/9/2023 8:08:22 AM	Google Patents	Search Term 1 link aggregation Search Term 2 failure detection Search Term 3 links Search Term 4 link Search Term 5 network Before Priority Date: priority:20070906
3/9/2023 8:18:24 AM	Google Scholar	(mirror leg) (pairing) (picture frame) (usb) (leg piece)
3/9/2023 8:18:24 AM	Google Patents	Search Term 1 (mirror leg) (pairing) (picture frame) (usb) (leg piece) Before Priority Date: priority:20071001
3/9/2023 8:18:26 AM	Google Scholar	mirror leg pairing picture frame usb leg piece

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date, time	web site	search string
3/9/2023 8:18:26 AM	Google Patents	Search Term 1 mirror leg Search Term 2 pairing Search Term 3 picture frame Search Term 4 usb Search Term 5 leg piece Before Priority Date: priority:20071001
3/9/2023 8:18:32 AM	Google Scholar	(dynamic range) (high dynamic) (image file) (image) (range image)
3/9/2023 8:18:32 AM	Google Patents	Search Term 1 (dynamic range) (high dynamic) (image file) (image) (range image) Before Priority Date: priority:20071023
3/9/2023 8:18:34 AM	Google Scholar	dynamic range high dynamic image file image range image
3/9/2023 8:18:34 AM	Google Patents	Search Term 1 dynamic range Search Term 2 high dynamic Search Term 3 image file Search Term 4 image Search Term 5 range image Before Priority Date: priority:20071023
3/9/2023 8:39:25 AM	Google Scholar	(signal) (antennas) (eyewear) (eyewear apparatus) (transmitting)
3/9/2023 8:39:25 AM	Google Patents	Search Term 1 (signal) (antennas) (eyewear) (eyewear apparatus) (transmitting) Before Priority Date: priority:20071212

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date, time	web site	search string
3/9/2023 8:39:27 AM	Google Scholar	signal antennas eyewear eyewear apparatus transmitting
3/9/2023 8:39:27 AM	Google Patents	Search Term 1 signal Search Term 2 antennas Search Term 3 eyewear Search Term 4 eyewear apparatus Search Term 5 transmitting Before Priority Date: priority:20071212
3/9/2023 8:39:33 AM	Google Scholar	(display device) (video) (display) (video signal) (compressed)
3/9/2023 8:39:33 AM	Google Patents	Search Term 1 (display device) (video) (display) (video signal) (compressed) Before Priority Date: priority:20080104
3/9/2023 8:39:35 AM	Google Scholar	display device video display video signal compressed
3/9/2023 8:39:35 AM	Google Patents	Search Term 1 display device Search Term 2 video Search Term 3 display Search Term 4 video signal Search Term 5 compressed Before Priority Date: priority:20080104
3/9/2023 8:39:41 AM	Google Scholar	(mobile device) (worn mobile) (worn) (design) (view)
3/9/2023 8:39:41 AM	Google Patents	Search Term 1 (mobile device) (worn mobile) (worn) (design) (view) Before Priority Date: priority:20080220

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date, time	web site	search string
3/9/2023 8:39:43 AM	Google Scholar	mobile device worn mobile worn design view
3/9/2023 8:39:43 AM	Google Patents	Search Term 1 mobile device Search Term 2 worn mobile Search Term 3 worn Search Term 4 design Search Term 5 view Before Priority Date: priority:20080220
3/9/2023 8:39:49 AM	Google Scholar	(host computer) (computer device) (portable wireless) (display device) (content)
3/9/2023 8:39:49 AM	Google Patents	Search Term 1 (host computer) (computer device) (portable wireless) (display device) (content) Before Priority Date: priority:20080328
3/9/2023 8:39:51 AM	Google Scholar	host computer computer device portable wireless display device content
3/9/2023 8:39:51 AM	Google Patents	Search Term 1 host computer Search Term 2 computer device Search Term 3 portable wireless Search Term 4 display device Search Term 5 content Before Priority Date: priority:20080328
3/9/2023 8:39:58 AM	Google Scholar	(signal) (warning device) (pin) (warning) (interest)
3/9/2023 8:39:58 AM	Google Patents	Search Term 1 (signal) (warning device) (pin) (warning) (interest) Before Priority Date: priority:20080424

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date, time	web site	search string
3/9/2023 8:39:59 AM	Google Scholar	signal warning device pin warning interest
3/9/2023 8:39:59 AM	Google Patents	Search Term 1 signal Search Term 2 warning device Search Term 3 pin Search Term 4 warning Search Term 5 interest Before Priority Date: priority:20080424
3/9/2023 8:40:06 AM	Google Scholar	(eyewear) (information) (unit) (aircraft) (units)
3/9/2023 8:40:06 AM	Google Patents	Search Term 1 (eyewear) (information) (unit) (aircraft) (units) Before Priority Date: priority:20080618
3/9/2023 8:40:08 AM	Google Scholar	eyewear information unit aircraft units
3/9/2023 8:40:08 AM	Google Patents	Search Term 1 eyewear Search Term 2 information Search Term 3 unit Search Term 4 aircraft Search Term 5 units Before Priority Date: priority:20080618
3/9/2023 8:40:15 AM	Google Scholar	(reception) (warning device) (frame incorporating) (eyeglass frame) (device incorporated)
3/9/2023 8:40:15 AM	Google Patents	Search Term 1 (reception) (warning device) (frame incorporating) (eyeglass frame) (device incorporated) Before Priority Date: priority:20080724

date, time	web site	search string
3/9/2023 8:40:16 AM	Google Scholar	reception warning device frame incorporating eyeglass frame device incorporated
3/9/2023 8:40:16 AM	Google Patents	Search Term 1 reception Search Term 2 warning device Search Term 3 frame incorporating Search Term 4 eyeglass frame Search Term 5 device incorporated Before Priority Date: priority:20080724
3/9/2023 8:40:40 AM	Google Scholar	(structured) (assembly) (earpiece) (processor) (disposed)
3/9/2023 8:40:40 AM	Google Patents	Search Term 1 (structured) (assembly) (earpiece) (processor) (disposed) Before Priority Date: priority:20080909
3/9/2023 8:40:42 AM	Google Scholar	structured assembly earpiece processor disposed
3/9/2023 8:40:42 AM	Google Patents	Search Term 1 structured Search Term 2 assembly Search Term 3 earpiece Search Term 4 processor Search Term 5 disposed Before Priority Date: priority:20080909
3/9/2023 9:09:18 AM	Google Scholar	(assembly) (structured) (disposed) (audio signal) (processor)
3/9/2023 9:09:18 AM	Google Patents	Search Term 1 (assembly) (structured) (disposed) (audio signal) (processor) Before Priority Date: priority:20080909

date, time	web site	search string
3/9/2023 9:09:21 AM	Google Scholar	assembly structured disposed audio signal processor
3/9/2023 9:09:21 AM	Google Patents	Search Term 1 assembly Search Term 2 structured Search Term 3 disposed Search Term 4 audio signal Search Term 5 processor Before Priority Date: priority:20080909
3/9/2023 9:09:28 AM	Google Scholar	(ophthalmic lens) (energized ophthalmic) (lens) (battery) (energy)
3/9/2023 9:09:28 AM	Google Patents	Search Term 1 (ophthalmic lens) (energized ophthalmic) (lens) (battery) (energy) Before Priority Date: priority:20090910
3/9/2023 9:09:30 AM	Google Scholar	ophthalmic lens energized ophthalmic lens battery energy
3/9/2023 9:09:30 AM	Google Patents	Search Term 1 ophthalmic lens Search Term 2 energized ophthalmic Search Term 3 lens Search Term 4 battery Search Term 5 energy Before Priority Date: priority:20090910
3/9/2023 9:09:36 AM	Google Scholar	(headset) (relative) (elevational view) (view relative) (design)
3/9/2023 9:09:36 AM	Google Patents	Search Term 1 (headset) (relative) (elevational view) (view relative) (design) Before Priority Date: priority:20080929

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date, time	web site	search string
3/9/2023 9:09:37 AM	Google Scholar	headset relative elevational view view relative design
3/9/2023 9:09:37 AM	Google Patents	Search Term 1 headset Search Term 2 relative Search Term 3 elevational view Search Term 4 view relative Search Term 5 design Before Priority Date: priority:20080929
3/9/2023 9:09:44 AM	Google Scholar	(headgear) (battery) (data) (data terminal) (video)
3/9/2023 9:09:44 AM	Google Patents	Search Term 1 (headgear) (battery) (data) (data terminal) (video) Before Priority Date: priority:20081104
3/9/2023 9:09:45 AM	Google Scholar	headgear battery data data terminal video
3/9/2023 9:09:45 AM	Google Patents	Search Term 1 headgear Search Term 2 battery Search Term 3 data Search Term 4 data terminal Search Term 5 video Before Priority Date: priority:20081104
3/9/2023 9:10:07 AM	Google Scholar	(video) (video data) (clip file) (recorded) (storage medium)
3/9/2023 9:10:07 AM	Google Patents	Search Term 1 (video) (video data) (clip file) (recorded) (storage medium) Before Priority Date: priority:20081107

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date, time	web site	search string
3/9/2023 9:10:35 AM	Google Patents	Search Term 1 (video) Search Term 2 (video data) Search Term 3 (clip file) Search Term 4 (recorded) Search Term 5 (storage medium) Before Priority Date: priority:20081107
3/9/2023 9:10:38 AM	Google Scholar	video video data clip file recorded storage medium
3/9/2023 9:10:38 AM	Google Patents	Search Term 1 video Search Term 2 video data Search Term 3 clip file Search Term 4 recorded Search Term 5 storage medium Before Priority Date: priority:20081107
3/9/2023 9:12:40 AM	Google Scholar	(video data) (headset) (video) (recorded) (wireless communication)
3/9/2023 9:12:40 AM	Google Patents	Search Term 1 (video data) (headset) (video) (recorded) (wireless communication) Before Priority Date: priority:20081107
3/9/2023 9:12:42 AM	Google Scholar	video data headset video recorded wireless communication

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date, time	web site	search string
3/9/2023 9:12:42 AM	Google Patents	Search Term 1 video data Search Term 2 headset Search Term 3 video Search Term 4 recorded Search Term 5 wireless communication Before Priority Date: priority:20081107
3/9/2023 9:12:51 AM	Google Scholar	(voice) (user) (coaching) (connection) (prompt)
3/9/2023 9:12:51 AM	Google Patents	Search Term 1 (voice) (user) (coaching) (connection) (prompt) Before Priority Date: priority:20081114
3/9/2023 9:12:52 AM	Google Scholar	voice user coaching connection prompt
3/9/2023 9:12:52 AM	Google Patents	Search Term 1 voice Search Term 2 user Search Term 3 coaching Search Term 4 connection Search Term 5 prompt Before Priority Date: priority:20081114
3/9/2023 9:13:02 AM	Google Scholar	(message) (bluetooth transceiver) (distance) (power) (bluetooth)
3/9/2023 9:13:02 AM	Google Patents	Search Term 1 (message) (bluetooth transceiver) (distance) (power) (bluetooth) Before Priority Date: priority:20081201
3/9/2023 9:13:03 AM	Google Scholar	message bluetooth transceiver distance power bluetooth

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date, time	web site	search string
3/9/2023 9:13:03 AM	Google Patents	Search Term 1 message Search Term 2 bluetooth transceiver Search Term 3 distance Search Term 4 power Search Term 5 bluetooth Before Priority Date: priority:20081201
3/9/2023 9:13:09 AM	Google Scholar	(module) (earpiece) (headset) (camera) (camera phone)
3/9/2023 9:13:09 AM	Google Patents	Search Term 1 (module) (earpiece) (headset) (camera) (camera phone) Before Priority Date: priority:20090227
3/9/2023 9:13:11 AM	Google Scholar	module earpiece headset camera camera phone
3/9/2023 9:13:11 AM	Google Patents	Search Term 1 module Search Term 2 earpiece Search Term 3 headset Search Term 4 camera Search Term 5 camera phone Before Priority Date: priority:20090227
3/9/2023 9:13:17 AM	Google Scholar	(motion) (remote control) (voice commands) (host application) (commands)
3/9/2023 9:13:17 AM	Google Patents	Search Term 1 (motion) (remote control) (voice commands) (host application) (commands) Before Priority Date: priority:20090508
3/9/2023 9:13:19 AM	Google Scholar	motion remote control voice commands host application commands

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date, time	web site	search string
3/9/2023 9:13:19 AM	Google Patents	Search Term 1 motion Search Term 2 remote control Search Term 3 voice commands Search Term 4 host application Search Term 5 commands Before Priority Date: priority:20090508
3/9/2023 9:13:25 AM	Google Scholar	(headband) (headset) (coupled) (torsion spring) (arm)
3/9/2023 9:13:25 AM	Google Patents	Search Term 1 (headband) (headset) (coupled) (torsion spring) (arm) Before Priority Date: priority:20090522
3/9/2023 9:13:27 AM	Google Scholar	headband headset coupled torsion spring arm
3/9/2023 9:13:27 AM	Google Patents	Search Term 1 headband Search Term 2 headset Search Term 3 coupled Search Term 4 torsion spring Search Term 5 arm Before Priority Date: priority:20090522
3/9/2023 9:13:33 AM	Google Scholar	(vibrator) (battery) (receiver) (alert device) (bracelet)
3/9/2023 9:13:33 AM	Google Patents	Search Term 1 (vibrator) (battery) (receiver) (alert device) (bracelet) Before Priority Date: priority:20090825
3/9/2023 9:13:35 AM	Google Scholar	vibrator battery receiver alert device bracelet

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date, time	web site	search string
3/9/2023 9:13:35 AM	Google Patents	Search Term 1 vibrator Search Term 2 battery Search Term 3 receiver Search Term 4 alert device Search Term 5 bracelet Before Priority Date: priority:20090825
3/9/2023 9:37:22 AM	Google Scholar	(headset) (speaker) (user) (microphone) (signal)
3/9/2023 9:37:22 AM	Google Patents	Search Term 1 (headset) (speaker) (user) (microphone) (signal) Before Priority Date: priority:20091105
3/9/2023 9:37:23 AM	Google Scholar	headset speaker user microphone signal
3/9/2023 9:37:23 AM	Google Patents	Search Term 1 headset Search Term 2 speaker Search Term 3 user Search Term 4 microphone Search Term 5 signal Before Priority Date: priority:20091105
3/9/2023 9:37:29 AM	Google Scholar	(eyewear) (view) (ornamental design) (elevational view) (side elevational)
3/9/2023 9:37:29 AM	Google Patents	Search Term 1 (eyewear) (view) (ornamental design) (elevational view) (side elevational) Before Priority Date: priority:20100104
3/9/2023 9:37:31 AM	Google Scholar	eyewear view ornamental design elevational view side elevational

date, time	web site	search string
3/9/2023 9:37:31 AM	Google Patents	Search Term 1 eyewear Search Term 2 view Search Term 3 ornamental design Search Term 4 elevational view Search Term 5 side elevational Before Priority Date: priority:20100104
3/9/2023 9:37:36 AM	Google Scholar	(microdisplay) (video) (user) (control) (user input)
3/9/2023 9:37:36 AM	Google Patents	Search Term 1 (microdisplay) (video) (user) (control) (user input) Before Priority Date: priority:20100205
3/9/2023 9:37:37 AM	Google Scholar	microdisplay video user control user input
3/9/2023 9:37:37 AM	Google Patents	Search Term 1 microdisplay Search Term 2 video Search Term 3 user Search Term 4 control Search Term 5 user input Before Priority Date: priority:20100205
3/9/2023 9:37:50 AM	Google Scholar	(light) (eyepiece) (image) (waveguide) (display)
3/9/2023 9:37:50 AM	Google Patents	Search Term 1 (light) (eyepiece) (image) (waveguide) (display) Before Priority Date: priority:20100228
3/9/2023 9:37:52 AM	Google Scholar	light eyepiece image waveguide display

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date, time	web site	search string
3/9/2023 9:37:52 AM	Google Patents	Search Term 1 light Search Term 2 eyepiece Search Term 3 image Search Term 4 waveguide Search Term 5 display Before Priority Date: priority:20100228
3/9/2023 9:38:01 AM	Google Scholar	(eyepiece) (user) (image) (lens) (content)
3/9/2023 9:38:01 AM	Google Patents	Search Term 1 (eyepiece) (user) (image) (lens) (content) Before Priority Date: priority:20100228
3/9/2023 9:38:04 AM	Google Scholar	eyepiece user image lens content
3/9/2023 9:38:04 AM	Google Patents	Search Term 1 eyepiece Search Term 2 user Search Term 3 image Search Term 4 lens Search Term 5 content Before Priority Date: priority:20100228
3/9/2023 9:38:12 AM	Google Scholar	(eyepiece) (light) (image) (pixel array) (optical)
3/9/2023 9:38:12 AM	Google Patents	Search Term 1 (eyepiece) (light) (image) (pixel array) (optical) Before Priority Date: priority:20100228
3/9/2023 9:38:14 AM	Google Scholar	eyepiece light image pixel array optical

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date, time	web site	search string
3/9/2023 9:38:14 AM	Google Patents	Search Term 1 eyepiece Search Term 2 light Search Term 3 image Search Term 4 pixel array Search Term 5 optical Before Priority Date: priority:20100228
3/9/2023 9:38:23 AM	Google Scholar	(light) (eyepiece) (image) (display) (optical)
3/9/2023 9:38:23 AM	Google Patents	Search Term 1 (light) (eyepiece) (image) (display) (optical) Before Priority Date: priority:20100228
3/9/2023 9:38:24 AM	Google Scholar	light eyepiece image display optical
3/9/2023 9:38:24 AM	Google Patents	Search Term 1 light Search Term 2 eyepiece Search Term 3 image Search Term 4 display Search Term 5 optical Before Priority Date: priority:20100228
3/9/2023 9:38:40 AM	Google Scholar	(mounted display) (eyepiece) (display device) (interactive head) (light)
3/9/2023 9:38:40 AM	Google Patents	Search Term 1 (mounted display) (eyepiece) (display device) (interactive head) (light) Before Priority Date: priority:20100228
3/9/2023 9:38:41 AM	Google Scholar	mounted display eyepiece display device interactive head light

date, time	web site	search string
3/9/2023 9:38:41 AM	Google Patents	Search Term 1 mounted display Search Term 2 eyepiece Search Term 3 display device Search Term 4 interactive head Search Term 5 light Before Priority Date: priority:20100228
3/9/2023 10:06:10 AM	Google Scholar	(eyepiece) (light) (items) (user) (optical)
3/9/2023 10:06:10 AM	Google Patents	Search Term 1 (eyepiece) (light) (items) (user) (optical) Before Priority Date: priority:20100228
3/9/2023 10:06:12 AM	Google Scholar	eyepiece light items user optical
3/9/2023 10:06:12 AM	Google Patents	Search Term 1 eyepiece Search Term 2 light Search Term 3 items Search Term 4 user Search Term 5 optical Before Priority Date: priority:20100228
3/9/2023 10:06:21 AM	Google Scholar	(eyepiece) (light) (user) (optical) (image)
3/9/2023 10:06:21 AM	Google Patents	Search Term 1 (eyepiece) (light) (user) (optical) (image) Before Priority Date: priority:20110406
3/9/2023 10:06:22 AM	Google Scholar	eyepiece light user optical image

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date, time	web site	search string
3/9/2023 10:06:22 AM	Google Patents	Search Term 1 eyepiece Search Term 2 light Search Term 3 user Search Term 4 optical Search Term 5 image Before Priority Date: priority:20110406
3/9/2023 10:06:31 AM	Google Scholar	(eyepiece) (light) (image) (optical) (lens)
3/9/2023 10:06:31 AM	Google Patents	Search Term 1 (eyepiece) (light) (image) (optical) (lens) Before Priority Date: priority:20100228
3/9/2023 10:06:32 AM	Google Scholar	eyepiece light image optical lens
3/9/2023 10:06:32 AM	Google Patents	Search Term 1 eyepiece Search Term 2 light Search Term 3 image Search Term 4 optical Search Term 5 lens Before Priority Date: priority:20100228
3/9/2023 10:06:41 AM	Google Scholar	(light) (eyepiece) (image) (user) (optical)
3/9/2023 10:06:41 AM	Google Patents	Search Term 1 (light) (eyepiece) (image) (user) (optical) Before Priority Date: priority:20100228
3/9/2023 10:06:43 AM	Google Scholar	light eyepiece image user optical

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date, time	web site	search string
3/9/2023 10:06:43 AM	Google Patents	Search Term 1 light Search Term 2 eyepiece Search Term 3 image Search Term 4 user Search Term 5 optical Before Priority Date: priority:20100228
3/9/2023 10:06:53 AM	Google Scholar	(eyepiece) (user) (light) (optical) (camera)
3/9/2023 10:06:53 AM	Google Patents	Search Term 1 (eyepiece) (user) (light) (optical) (camera) Before Priority Date: priority:20100228
3/9/2023 10:06:54 AM	Google Scholar	eyepiece user light optical camera
3/9/2023 10:06:54 AM	Google Patents	Search Term 1 eyepiece Search Term 2 user Search Term 3 light Search Term 4 optical Search Term 5 camera Before Priority Date: priority:20100228
3/9/2023 10:07:08 AM	Google Scholar	(brightness) (display) (eyepiece) (light) (optical)
3/9/2023 10:07:08 AM	Google Patents	Search Term 1 (brightness) (display) (eyepiece) (light) (optical) Before Priority Date: priority:20100228
3/9/2023 10:07:10 AM	Google Scholar	brightness display eyepiece light optical

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date, time	web site	search string
3/9/2023 10:07:10 AM	Google Patents	Search Term 1 brightness Search Term 2 display Search Term 3 eyepiece Search Term 4 light Search Term 5 optical Before Priority Date: priority:20100228
3/9/2023 10:07:18 AM	Google Scholar	(light) (display) (image) (optical) (wedge)
3/9/2023 10:07:18 AM	Google Patents	Search Term 1 (light) (display) (image) (optical) (wedge) Before Priority Date: priority:20100228
3/9/2023 10:07:20 AM	Google Scholar	light display image optical wedge
3/9/2023 10:07:20 AM	Google Patents	Search Term 1 light Search Term 2 display Search Term 3 image Search Term 4 optical Search Term 5 wedge Before Priority Date: priority:20100228
3/9/2023 10:07:27 AM	Google Scholar	(eyepiece) (light) (image) (user) (optical)
3/9/2023 10:07:27 AM	Google Patents	Search Term 1 (eyepiece) (light) (image) (user) (optical) Before Priority Date: priority:20100228
3/9/2023 10:07:29 AM	Google Scholar	eyepiece light image user optical

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date, time	web site	search string
3/9/2023 10:07:29 AM	Google Patents	Search Term 1 eyepiece Search Term 2 light Search Term 3 image Search Term 4 user Search Term 5 optical Before Priority Date: priority:20100228
3/9/2023 10:13:58 AM	Google Scholar	(light) (eyepiece) (optical) (image) (display)
3/9/2023 10:13:58 AM	Google Patents	Search Term 1 (light) (eyepiece) (optical) (image) (display) Before Priority Date: priority:20100228
3/9/2023 10:13:59 AM	Google Scholar	light eyepiece optical image display
3/9/2023 10:13:59 AM	Google Patents	Search Term 1 light Search Term 2 eyepiece Search Term 3 optical Search Term 4 image Search Term 5 display Before Priority Date: priority:20100228
3/9/2023 10:14:26 AM	Google Scholar	(wearer) (input) (audio) (speaker) (source)
3/9/2023 10:14:26 AM	Google Patents	Search Term 1 (wearer) (input) (audio) (speaker) (source) Before Priority Date: priority:20041222
3/9/2023 10:14:28 AM	Google Scholar	wearer input audio speaker source

date, time	web site	search string
3/9/2023 10:14:28 AM	Google Patents	Search Term 1 wearer Search Term 2 input Search Term 3 audio Search Term 4 speaker Search Term 5 source Before Priority Date: priority:20041222
3/9/2023 10:14:35 AM	Google Scholar	(audio device) (speaker) (wearable wireless) (audio) (wireless audio)
3/9/2023 10:14:35 AM	Google Patents	Search Term 1 (audio device) (speaker) (wearable wireless) (audio) (wireless audio) Before Priority Date: priority:20041119
3/9/2023 10:14:37 AM	Google Scholar	audio device speaker wearable wireless audio wireless audio
3/9/2023 10:14:37 AM	Google Patents	Search Term 1 audio device Search Term 2 speaker Search Term 3 wearable wireless Search Term 4 audio Search Term 5 wireless audio Before Priority Date: priority:20041119
3/9/2023 10:14:43 AM	Google Scholar	(audio) (loop member) (individual) (wearable personal) (audio apparatus)
3/9/2023 10:14:43 AM	Google Patents	Search Term 1 (audio) (loop member) (individual) (wearable personal) (audio apparatus) Before Priority Date: priority:19960812

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date, time	web site	search string
3/9/2023 10:14:44 AM	Google Scholar	audio loop member individual wearable personal audio apparatus
3/9/2023 10:14:44 AM	Google Patents	Search Term 1 audio Search Term 2 loop member Search Term 3 individual Search Term 4 wearable personal Search Term 5 audio apparatus Before Priority Date: priority:19960812
3/9/2023 10:14:50 AM	Google Scholar	(housings) (temples) (glasses) (housing) (equipment according)
3/9/2023 10:14:50 AM	Google Patents	Search Term 1 (housings) (temples) (glasses) (housing) (equipment according) Before Priority Date: priority:20050510
3/9/2023 10:14:51 AM	Google Scholar	housings temples glasses housing equipment according
3/9/2023 10:14:51 AM	Google Patents	Search Term 1 housings Search Term 2 temples Search Term 3 glasses Search Term 4 housing Search Term 5 equipment according Before Priority Date: priority:20050510
3/9/2023 10:15:02 AM	Google Scholar	(wireless microphone) (functional module) (interchangeable functional) (coupling element) (module)

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date, time	web site	search string
3/9/2023 10:15:02 AM	Google Patents	Search Term 1 (wireless microphone) (functional module) (interchangeable functional) (coupling element) (module) Before Priority Date: priority:20031007
3/9/2023 10:15:04 AM	Google Scholar	wireless microphone functional module interchangeable functional coupling element module
3/9/2023 10:15:04 AM	Google Patents	Search Term 1 wireless microphone Search Term 2 functional module Search Term 3 interchangeable functional Search Term 4 coupling element Search Term 5 module Before Priority Date: priority:20031007
3/9/2023 10:15:12 AM	Google Scholar	(eyewear) (frame) (transceiver) (temple) (alarm)
3/9/2023 10:15:13 AM	Google Scholar	eyewear frame transceiver temple alarm
3/9/2023 10:15:13 AM	Google Patents	Search Term 1 eyewear Search Term 2 frame Search Term 3 transceiver Search Term 4 temple Search Term 5 alarm Before Priority Date: priority:20020429
3/9/2023 10:15:19 AM	Google Scholar	(bone) (butterfly) (conduction) (signal) (oscillating)
3/9/2023 10:15:19 AM	Google Patents	Search Term 1 (bone) (butterfly) (conduction) (signal) (oscillating) Before Priority Date: priority:20081128

date, time	web site	search string
3/9/2023 10:15:21 AM	Google Scholar	bone butterfly conduction signal oscillating
3/9/2023 10:15:21 AM	Google Patents	Search Term 1 bone Search Term 2 butterfly Search Term 3 conduction Search Term 4 signal Search Term 5 oscillating Before Priority Date: priority:20081128
3/9/2023 10:15:27 AM	Google Scholar	(loudspeaker) (wearable wireless) (audio devices) (wireless audio) (wearable)
3/9/2023 10:15:27 AM	Google Patents	Search Term 1 (loudspeaker) (wearable wireless) (audio devices) (wireless audio) (wearable) Before Priority Date: priority:20041119
3/9/2023 10:15:29 AM	Google Scholar	loudspeaker wearable wireless audio devices wireless audio wearable
3/9/2023 10:15:29 AM	Google Patents	Search Term 1 loudspeaker Search Term 2 wearable wireless Search Term 3 audio devices Search Term 4 wireless audio Search Term 5 wearable Before Priority Date: priority:20041119
3/9/2023 10:15:34 AM	Google Scholar	(glasses) (function) (input) (eyeglasses) (leisure)
3/9/2023 10:15:34 AM	Google Patents	Search Term 1 (glasses) (function) (input) (eyeglasses) (leisure) Before Priority Date: priority:20050304

date, time	web site	search string
3/9/2023 10:15:36 AM	Google Scholar	glasses function input eyeglasses leisure
3/9/2023 10:15:36 AM	Google Patents	Search Term 1 glasses Search Term 2 function Search Term 3 input Search Term 4 eyeglasses Search Term 5 leisure Before Priority Date: priority:20050304
3/9/2023 10:15:48 AM	Google Scholar	(audio) (source) (interface) (wearable) (wearer)
3/9/2023 10:15:48 AM	Google Patents	Search Term 1 (audio) (source) (interface) (wearable) (wearer) Before Priority Date: priority:20041119
3/9/2023 10:15:50 AM	Google Scholar	audio source interface wearable wearer
3/9/2023 10:15:50 AM	Google Patents	Search Term 1 audio Search Term 2 source Search Term 3 interface Search Term 4 wearable Search Term 5 wearer Before Priority Date: priority:20041119

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Global Dossier

Office

US

Type

Application

17873104

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US 17873104 81 Members in Patent Family (79 currently shown) ()

« ()

IP Office Type

All IP5 Offices
- EP
- CN
- KR
- JP
- US

Non-IP5 Offices

()	Office ()	Application ()	Assignee	Title ()	App. Date ()	Priority #	Pub. # ()	Pub. Date	A
()	US	10822218 View Dossier ()	1) Thomas, C. Douglass 2) Tong, Peter P.	EYEGLASSES FOR WIRELESS COMMUNICATIONS	04/12/2004	US 60527565 US 60462591 US 10822218 US 60509631	US 20060003803 A1 () US 7792552 B2 ()	01/05/2006 09/07/2010	
()	US	10964011 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES	10/12/2004	US 60527565 US 60583169 US 60509631 US 10964011 US 60562798 US 60618107 US 60462591 US 60605191 US 60592045	US 20050078274 A1 () US 7192136 B2 ()	04/14/2005 03/20/2007	
()	US	11006343 View Dossier ()	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	12/07/2004	US 11006343 US 60527565	US 20050124324 A1 () US 7116976 B2 ()	06/09/2005 10/03/2006	
()	US	11078857 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	Radiation monitoring system	03/11/2005	US 60647826 US 60583169 US 60562798 US 60620238 US 60618107 US 60605191 US 11078857 US 60592045 US 60647836	US 20050230596 A1 ()	10/20/2005	
()	US	11078855 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH RADIATION DETECTION SYSTEM	03/11/2005	US 60647826 US 60583169 US 11078855 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20090059159 A1 () US 7500746 B1 ()	03/05/2009 03/10/2009	
()	CN	200510067143 Refresh Dossier ()			04/14/2005	US 60562798	CN 1700059 A () CN 100580507 C ()	11/23/2005 01/13/2010	

⊞ ()	Office ⇕ ()	Application ⇕ ()	Assignee	Title ⇕ ()	App. Date ⇕ ()	Priority #	Pub. # ⓘ ()	Pub. Date	A
⚠ ()	CN	200520016479 Refresh Dossier ()			04/14/2005	US 60562798	CN 2859575 Y ()	01/17/2007	
⊞ ()	US	11183269 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING AFTER-MARKET ELECTRICAL COMPONENTS	07/15/2005	US 60647826 US 60527565 US 60583169 US 11183269 US 60509631 US 10964011 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20050264752 A1 () US 7922321 B2 ()	12/01/2005 04/12/2011	
⊞ ()	US	11183263 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH A CLOCK OR OTHER ELECTRICAL COMPONENT	07/15/2005	US 60647826 US 60527565 US 60583169 US 60509631 US 10964011 US 60562798 US 60620238 US 60618107 US 60605191 US 11183263 US 60592045 US 60647836	US 20060001827 A1 () US 7380936 B2 ()	01/05/2006 06/03/2008	
⊞ ()	US	11183256 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH ELECTRICAL COMPONENTS	07/15/2005	US 60647826 US 60527565 US 60583169 US 60509631 US 10964011 US 60562798 US 60620238 US 60618107 US 60605191 US 11183256 US 60592045 US 60647836	US 20060023158 A1 () US 7500747 B2 ()	02/02/2006 03/10/2009	
⊞ ()	US	11183262 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH HEARING ENHANCED AND OTHER AUDIO SIGNAL-GENERATING CAPABILITIES	07/15/2005	US 60647826 US 60527565 US 60583169 US 60509631 US 10964011 US 60562798 US 11183262 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20050248717 A1 () US 7760898 B2 ()	11/10/2005 07/20/2010	
⊞ ()	US	11183283 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	Event eyeglasses	07/15/2005	US 60647826 US 60527565 US 60583169 US 60509631 US 11183283 US 10964011 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20050248719 A1 ()	11/10/2005	

⊞ ()	Office ⇕ ()	Application ⇕ ()	Assignee	Title ⇕ ()	App. Date ⇕ ()	Priority #	Pub. # ⓘ ()	Pub. Date	A
⊞ ()	US	11183276 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH ACTIVITY MONITORING	07/15/2005	US 60647826 US 60527565 US 60583169 US 11183276 US 60509631 US 10964011 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20050248718 A1 () US 7255437 B2 ()	11/10/2005 08/14/2007	
⚠ ()	US	PCT/US06/22015 Refresh Dossier ()			06/07/2006	US 60689686	WO 2006135614 A2 () WO 2006135614 A3 () WO 2006135614 A8 () WO 2006135614 A9 ()	12/21/2006 03/22/2007 07/10/2008 12/11/2008	
⚠ ()	CN	200680027964 Refresh Dossier ()			06/07/2006	US 60689686	CN 101297191 A ()	10/29/2008	
⊞ ()	US	11452115 View Dossier () ⬚	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	SYSTEMS AND PROCESSES TO MANAGE MULTIPLE MODES OF COMMUNICATION	06/12/2006	US 11452115 US 60689686 US 11006343 US 60527565	US 20060259565 A1 () US 7729688 B2 ()	11/16/2006 06/01/2010	
⊞ ()	US	11497651 View Dossier () ⬚	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	08/02/2006	US 11006343 US 60527565 US 11497651	US 20060276210 A1 () US 7376434 B2 ()	12/07/2006 05/20/2008	
⊞ ()	US	11521256 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES	09/13/2006	US 11521256 US 60527565 US 60583169 US 60509631 US 10964011 US 60562798 US 60605191 US 60592045	US 7438410 B1 ()	10/21/2008	
⊞ ()	US	11580222 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING AFTER-MARKET ELECTRICAL COMPONENTS	10/11/2006	US 60583169 US 60725896 US 11183269 US 60787850 US 60846150 US 10964011 US 60725999 US 60527565 US 60509631 US 60562798 US 60620238 US 11580222 US 60618107 US 60605191 US 60592045 US 60647836	US 20070046887 A1 () US 7581833 B2 ()	03/01/2007 09/01/2009	

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⊞ ()	US	11546685 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES HAVING A CAMERA	10/11/2006	US 60583169 US 60725896 US 11546685 US 60787850 US 60846150 US 10964011 US 60725999 US 11183256 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20070030442 A1 () US 7806525 B2 ()	02/08/2007 10/05/2010	
⊞ ()	US	11650626 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Day, Robert Grant 5) Tong, Peter P.	EYEGLASSES WITH A HEART RATE MONITOR	01/06/2007	US 11650626 US 60583169 US 60787850 US 60846150 US 10964011 US 11183256 US 60647826 US 60527565 US 60509631 US 60763854 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20070109491 A1 () US 7677723 B2 ()	05/17/2007 03/16/2010	
⊞ ()	US	11700550 View Dossier () ⬚	1) Howell, Thomas A. 2) Tong, Peter P. 3) Thomas, C. Douglass	Hat with a radiation sensor	01/30/2007	US 60583169 US 11700550 US 11078855 US 60787850 US 60846150 US 60647826 US 60763854 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20070186330 A1 ()	08/16/2007	
⚠ ()	CN	200710090621 Refresh Dossier ()			04/02/2007	US 60787850	CN 101046557 A ()	10/03/2007	
⊞ ()	US	11891411 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH ACTIVITY MONITORING	08/09/2007	US 60583169 US 11183276 US 10964011 US 11891411 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20070279584 A1 () US 7401918 B2 ()	12/06/2007 07/22/2008	

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⊞ ()	US	11903512 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Lee, Yeou-Soon 4) Thomas, C. Douglass 5) Tong, Peter P.	EYEGLASSES WITH ACTIVITY MONITORING AND ACOUSTIC DAMPENING	09/20/2007	US 60846150 US 11903512	US 20080068559 A1 () US 7543934 B2 ()	03/20/2008 06/09/2009	
⊞ ()	US	12074302 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES	03/03/2008	US 11521256 US 60527565 US 60583169 US 60509631 US 10964011 US 60562798 US 12074302 US 60605191 US 60592045	US 20080151179 A1 () US 7621634 B2 ()	06/26/2008 11/24/2009	
⊞ ()	US	12074961 View Dossier ()	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	03/07/2008	US 11497651 US 12074961 US 11006343 US 60527565	US 7890128 B1 ()	02/15/2011	
⊞ ()	US	12152480 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH RFID TAGS OR WITH A STRAP	05/13/2008	US 60647826 US 60620238 US 60618107 US 60605191 US 11183263 US 12152480 US 60592045 US 60647836	US 20080218684 A1 () US 8337013 B2 ()	09/11/2008 12/25/2012	
⊞ ()	US	12214435 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH USER MONITORING	06/19/2008	US 60583169 US 11183276 US 10964011 US 11891411 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 12214435 US 60605191 US 60592045 US 60647836	US 20080278678 A1 () US 7481531 B2 ()	11/13/2008 01/27/2009	
⊞ ()	US	12317043 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH MONITORING CAPABILITY	12/18/2008	US 60583169 US 11183276 US 10964011 US 11891411 US 12317043 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 12214435 US 60605191 US 60592045 US 60647836	US 20090141233 A1 () US 7771046 B2 ()	06/04/2009 08/10/2010	

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⊞ ()	US	12322377 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	Eyewear with radiation detection system	02/02/2009	US 60647826 US 60583169 US 12322377 US 11078855 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20090147215 A1 () US 8770742 B2 ()	06/11/2009 07/08/2014	
⊞ ()	US	12462286 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING ELECTRICAL COMPONENTS AND APPARATUS THEREFOR	07/31/2009	US 60583169 US 60725896 US 11183269 US 60787850 US 60846150 US 10964011 US 60725999 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 11580222 US 60618107 US 60605191 US 12462286 US 60592045 US 60647836	US 20090296044 A1 () US 8109629 B2 ()	12/03/2009 02/07/2012	
⊞ ()	US	12798995 View Dossier ()	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	SYSTEMS AND PROCESSES TO MANAGE MULTIPLE MODES OF COMMUNICATION	04/14/2010	US 11452115 US 60689686 US 11006343 US 60527565 US 12798995	US 20100205272 A1 () US 8744407 B2 ()	08/12/2010 06/03/2014	
⊞ ()	US	12803732 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEGLASSES WITH A PRINTED CIRCUIT BOARD	07/01/2010	US 60583169 US 60725896 US 11546685 US 60787850 US 60846150 US 10964011 US 12803732 US 60725999 US 11183256 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20110102734 A1 () US 8434863 B2 ()	05/05/2011 05/07/2013	

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⊞ ()	US	12806312 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH MULTI-PART TEMPLE FOR SUPPORTING ONE OR MORE ELECTRICAL COMPONENTS	08/10/2010	US 60583169 US 60725896 US 60787850 US 10822218 US 11891411 US 60647826 US 60527565 US 12214435 US 60605191 US 12462286 US 60592045 US 60647836 US 11183269 US 11183276 US 60846150 US 10964011 US 12806312 US 60725999 US 12317043 US 60509631 US 60562798 US 60620238 US 11580222 US 60618107 US 60462591	US 20100309426 A1 () US 8465151 B2 ()	12/09/2010 06/18/2013	
⊞ ()	US	12987018 View Dossier ()	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	01/07/2011	US 12987018 US 11497651 US 12074961 US 11006343 US 60527565	US 8112104 B1 ()	02/07/2012	
⊞ ()	US	13085402 View Dossier ()	1) HOWELL, THOMAS A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING AFTER-MARKET ELECTRICAL COMPONENTS	04/12/2011	US 60583169 US 11183269 US 10964011 US 13085402 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20110187990 A1 () US 8500271 B2 ()	08/04/2011 08/06/2013	
⊞ ()	US	13291020 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglas 4) Tong, Peter P.	EYEWEAR WITH TOUCH-SENSITIVE INPUT SURFACE	11/07/2011	US 60583169 US 60725896 US 11546685 US 60787850 US 60846150 US 10964011 US 12803732 US 60725999 US 11183256 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 60618107 US 13291020 US 60605191 US 60592045 US 60647836	US 20120050668 A1 () US 8430507 B2 ()	03/01/2012 04/30/2013	
⊞ ()	US	13363360 View Dossier ()	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	01/31/2012	US 12987018 US 11497651 US 12074961 US 11006343 US 60527565 US 13363360	US 8280419 B1 ()	10/02/2012	

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⊞ ()	US	13367346 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING ELECTRICAL COMPONENTS AND APPARATUS THEREFOR	02/06/2012	US 60583169 US 60725896 US 11078855 US 60787850 US 13367346 US 10822218 US 60647826 US 60527565 US 60605191 US 12462286 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 60725999 US 11183256 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 11580222 US 60618107 US 11078857 US 11183263	US 20120133885 A1 () US 9033493 B2 ()	05/31/2012 05/19/2015	
⊞ ()	US	13593483 View Dossier () ⬚	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	08/23/2012	US 12987018 US 11497651 US 13593483 US 11006343 US 60527565 US 13363360 US 12074961	US 8737978 B1 ()	05/27/2014	
⊞ ()	US	13831445 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH PRINTED CIRCUIT BOARD	03/14/2013	US 60583169 US 60725896 US 11078855 US 60787850 US 10822218 US 60647826 US 60527565 US 60605191 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 12803732 US 60725999 US 11183256 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 60618107 US 13831445 US 11078857 US 11183263	US 20140268013 A1 () US 20170068117 A9 () US 10310296 B2 ()	09/18/2014 03/09/2017 06/04/2019	

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⊞ ()	US	13831512 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING ONE OR MORE ELECTRICAL COMPONENTS	03/14/2013	US 60583169 US 60725896 US 11078855 US 60787850 US 10822218 US 11891411 US 60647826 US 60527565 US 12214435 US 60605191 US 13831512 US 12462286 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 12806312 US 60725999 US 11183256 US 12317043 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 11580222 US 60618107 US 60462591 US 11078857 US 11183263	US 20130201440 A1 () US 9690121 B2 ()	08/08/2013 06/27/2017	
⊞ ()	US	13831455 View Dossier () ⬚	1) Damerdji, Halim 2) Sankaran, Ayyappan 3) Kaushik, Vijay	System and Method for Statistically Determining Bias in Online Survey Results	03/14/2013	US 13831455	US 20140278782 A1 ()	09/18/2014	
⊞ ()	US	13831419 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH TOUCH-SENSITIVE INPUT SURFACE	03/14/2013	US 60583169 US 60725896 US 11078855 US 60787850 US 10822218 US 60647826 US 60527565 US 13291020 US 60605191 US 13831419 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 12803732 US 60725999 US 11183256 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 11580222 US 60618107 US 11078857 US 11183263	US 20140268008 A1 () US 20160246075 A9 () US 10345625 B2 ()	09/18/2014 08/25/2016 07/09/2019	

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⊞ ()	US	13955336 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING BONE CONDUCTING SPEAKER	07/31/2013	US 60583169 US 11078855 US 11183269 US 11183276 US 10964011 US 13955336 US 10822218 US 13085402 US 11183256 US 60647826 US 11006343 US 60527565 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 60618107 US 60605191 US 11078857 US 11183263 US 60592045 US 60647836	US 20130308089 A1 () US 8905542 B2 ()	11/21/2013 12/09/2014	
⊞ ()	EP	14158720 View Dossier ()	1) Yume, Inc.,	System and method for statistically determining bias in online survey results	03/11/2014	US 13831455	EP 2779074 A1 ()	09/17/2014	
⊞ ()	CN	201410096316 View Dossier ()	1) YUME, INC.,	System and method for statistically determining bias in online survey results	03/14/2014	US 13831455	CN 104050228 A ()	09/17/2014	
⊞ ()	US	14272632 View Dossier ()	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	SYSTEMS AND PROCESSES TO MANAGE MULTIPLE MODES OF COMMUNICATION	05/08/2014	US 11452115 US 60689686 US 11006343 US 60527565 US 12798995 US 14272632	US 20140242956 A1 () US 9204268 B2 ()	08/28/2014 12/01/2015	
⊞ ()	US	14286976 View Dossier ()	1) Thomas, C. Douglass 2) Tong, Peter P.	ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES	05/23/2014	US 12987018 US 11497651 US 13593483 US 11006343 US 60527565 US 13363360 US 14286976 US 12074961	US 20140256293 A1 () US 11019199 B2 ()	09/11/2014 05/25/2021	
⊞ ()	US	14313989 View Dossier ()	1) HOWELL, THOMAS A. 2) CHAO, DAVID 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH RADIATION DETECTION SYSTEM	06/24/2014	US 14313989 US 60583169 US 12322377 US 11078855 US 10964011 US 10822218 US 60647826 US 11006343 US 60562798 US 60620238 US 60618107 US 60605191 US 11078857 US 60592045 US 60647836	US 20140361185 A1 () US 9488520 B2 ()	12/11/2014 11/08/2016	

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⊞ ()	US	14557409 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING EMBEDDED ELECTRONIC COMPONENTS	12/01/2014	US 60583169 US 11078855 US 11183269 US 11183276 US 10964011 US 13955336 US 10822218 US 13085402 US 11183256 US 14557409 US 60647826 US 11006343 US 60527565 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 60618107 US 60605191 US 11078857 US 11183263 US 60592045 US 60647836	US 20150085245 A1 () US 9547184 B2 ()	03/26/2015 01/17/2017	
⊞ ()	US	14715501 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING ELECTRICAL COMPONENTS AND APPARATUS THEREFOR	05/18/2015	US 14715501 US 60583169 US 60725896 US 11078855 US 60787850 US 13367346 US 10822218 US 60647826 US 60527565 US 60605191 US 12462286 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 60725999 US 11183256 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 11580222 US 60618107 US 11078857 US 11183263	US 20150253590 A1 () US 10330956 B2 ()	09/10/2015 06/25/2019	
⊞ ()	US	14922344 View Dossier () ⬚	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	SYSTEMS AND PROCESSES TO MANAGE MULTIPLE MODES OF COMMUNICATION	10/26/2015	US 14922344 US 11006343 US 60527565 US 14272632 US 11452115 US 60689686 US 12798995	US 20160044474 A1 () US 9736664 B2 ()	02/11/2016 08/15/2017	

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⊞ ()	US	15343472 View Dossier () ⬚	1) HOWELL, THOMAS A. 2) CHAO, DAVID 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH RADIATION DETECTION SYSTEM	11/04/2016	US 14313989 US 60583169 US 12322377 US 11078855 US 10964011 US 10822218 US 60647826 US 15343472 US 11006343 US 60562798 US 60620238 US 60618107 US 60605191 US 11078857 US 60592045 US 60647836	US 20170074721 A1 () US 10060790 B2 ()	03/16/2017 08/28/2018	
⊞ ()	US	15375423 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING EMBEDDED ELECTRONIC COMPONENTS	12/12/2016	US 60583169 US 11078855 US 10822218 US 13085402 US 60647826 US 60527565 US 15375423 US 60605191 US 60592045 US 60647836 US 11183269 US 11183276 US 10964011 US 13955336 US 11183256 US 14557409 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 60618107 US 11078857 US 11183263	US 20170090219 A1 () US 10061144 B2 ()	03/30/2017 08/28/2018	

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⊞ ()	US	15396428 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING ONE OR MORE ELECTRICAL COMPONENTS	12/31/2016	US 60583169 US 60725896 US 11078855 US 60787850 US 10822218 US 11891411 US 15396428 US 60647826 US 60527565 US 12214435 US 60605191 US 13831512 US 12462286 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 12806312 US 60725999 US 11183256 US 12317043 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 11580222 US 60618107 US 60462591 US 11078857 US 11183263	US 20170146829 A1 ()	05/25/2017	
⊞ ()	US	15409723 View Dossier () ⬚	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR HOUSING FOR CHARGING EMBEDDED BATTERY IN EYEWEAR FRAME	01/19/2017	US 60583169 US 60725896 US 11078855 US 60787850 US 10822218 US 11891411 US 60647826 US 15409723 US 60527565 US 12214435 US 60605191 US 13831512 US 12462286 US 60592045 US 60647836 US 11183269 US 11183276 US 11546685 US 60846150 US 10964011 US 12806312 US 60725999 US 11183256 US 12317043 US 11006343 US 60509631 US 11183283 US 60562798 US 11183262 US 60620238 US 11580222 US 60618107 US 60462591 US 11078857 US 11183263	US 20170131575 A1 ()	05/11/2017	

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⊞ ()	US	15469440 View Dossier ()	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	METHOD AND APPARATUS TO MANAGE DIFFERENT OPTIONS OF COMMUNICATION USING ONE USER IDENTIFIER BASED ON INTERNET PROTOCOL	03/24/2017	US 14922344 US 11006343 US 60527565 US 14272632 US 15469440 US 11452115 US 60689686 US 12798995	US 20170201872 A1 () US 10142810 B2 ()	07/13/2017 11/27/2018	
⊞ ()	US	15704181 View Dossier ()	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	METHOD AND APPARATUS TO MANAGE MESSAGING PROVIDING DIFFERENT COMMUNICATION MODES DEPENDING ON ONE IDENTIFIER AND NOT REQUIRING AND NOT REQUIRING TO DISCLOSE CONTACT INFORMATION	09/14/2017	US 14922344 US 11006343 US 60527565 US 14272632 US 15469440 US 11452115 US 60689686 US 15704181 US 12798995	US 20180014169 A1 () US 10492038 B2 ()	01/11/2018 11/26/2019	
⊞ ()	US	16049120 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING EMBEDDED ELECTRONIC COMPONENTS	07/30/2018	US 60583169 US 11183269 US 10964011 US 13955336 US 13085402 US 16049120 US 14557409 US 60647826 US 60527565 US 60509631 US 15375423 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20180335650 A1 () US 11243416 B2 ()	11/22/2018 02/08/2022	
⊞ ()	US	16102859 View Dossier ()	1) HOWELL, THOMAS A. 2) CHAO, DAVID 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH RADIATION DETECTION SYSTEM	08/14/2018	US 14313989 US 60583169 US 12322377 US 11078855 US 16102859 US 60647826 US 15343472 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20180348050 A1 () US 10359311 B2 ()	12/06/2018 07/23/2019	

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⊞ ()	US	16127957 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING ELECTRICAL COMPONENTS AND APPARATUS THEREFOR	09/11/2018	US 14715501 US 60583169 US 60725896 US 11183269 US 60787850 US 60846150 US 10964011 US 13367346 US 60725999 US 16127957 US 60647826 US 60527565 US 60509631 US 60562798 US 60620238 US 11580222 US 60618107 US 60605191 US 12462286 US 60592045 US 60647836	US 20190033623 A1 () US 11086147 B2 ()	01/31/2019 08/10/2021	
⊞ ()	US	16182969 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR HOUSING FOR CHARGING EMBEDDED BATTERY IN EYEWEAR FRAME	11/07/2018	US 14715501 US 60583169 US 60725896 US 60787850 US 13367346 US 10822218 US 13085402 US 11891411 US 60647826 US 15409723 US 60527565 US 15375423 US 12214435 US 60605191 US 13831512 US 12462286 US 60592045 US 60647836 US 16182969 US 11183269 US 11183276 US 60846150 US 10964011 US 13955336 US 12806312 US 16049120 US 60725999 US 16127957 US 12317043 US 14557409 US 60509631 US 60562798 US 60620238 US 11580222 US 60618107 US 60462591	US 20190187492 A1 () US 20210364827 A9 ()	06/20/2019 11/25/2021	

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⊞ ()	US	16426351 View Dossier ()	1) HOWELL, THOMAS A. 2) CHAO, DAVID 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR WITH DETECTION SYSTEM	05/30/2019	US 14313989 US 60583169 US 12322377 US 11078855 US 16102859 US 16426351 US 60647826 US 15343472 US 60562798 US 60620238 US 60618107 US 60605191 US 60592045 US 60647836	US 20190310132 A1 () US 10539459 B2 ()	10/10/2019 01/21/2020	
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⊞ ()	US	16556205 View Dossier ()	1) Cheung, Kwok Wai 2) Tong, Peter P. 3) Thomas, C. Douglass	METHOD AND APPARATUS TO MANAGE MESSAGING PROVIDING DIFFERENT COMMUNICATION MODES USING ONE IDENTIFIER AND NOT REQUIRING TO DISCLOSE CONTACT INFORMATION	08/29/2019	US 14922344 US 11006343 US 60527565 US 14272632 US 15469440 US 11452115 US 60689686 US 15704181 US 12798995 US 16556205	US 20190387371 A1 () US 10708727 B2 ()	12/19/2019 07/07/2020	
⊞ ()	US	16574254 View Dossier ()	1) Howell, Thomas A. 2) Chao, David 3) Thomas, C. Douglass 4) Tong, Peter P.	EYEWEAR SUPPORTING EMBEDDED AND TETHERED ELECTRONIC COMPONENTS	09/18/2019	US 60583169 US 11183269 US 10964011 US 13955336 US 13085402 US 16049120 US 14557409 US 60647826 US 60527565 US 60509631 US 15375423 US 60562798 US 60620238 US 60618107 US 16574254 US 60605191 US 60592045 US 60647836	US 20200012127 A1 () US 11204512 B2 ()	01/09/2020 12/21/2021	
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USPTO BACKGROUND

FEDERAL GOVERNMENT

Form 1449 (Modified)	Atty. Docket No.	IPVCP003C10
	Application No.:	17/873,104
Information Disclosure Statement By Applicant	Applicant	HOWELL et al.
	Filing Date	July 25, 2022
	Group	2872
(Use Several Sheets if Necessary)		Page 1 of 3

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Examiner	Date Considered

Examiner: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.L/

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	Application No.:	17/873,104
Information Disclosure	Applicant	HOWELL et al.
Statement By Applicant	Filing Date	July 25, 2022
	Group	2872
(Use Several Sheets if Necessary)		Page 2 of 3

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Form 1449 (Modified) Information Disclosure Statement By Applicant (Use Several Sheets if Necessary)	Atty. Docket No.	IPVCP003C10
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	E	Notice of Allowance for U.S. Patent Application No. 17/949,029, dated March 1, 2023.
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Examiner	Date Considered
/JIE LEI/	03/08/2023

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1112	4	"17873104"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/08 03:59 PM
L1113	14	"15375423"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/08 03:59 PM
L1114	17	"46304853".fmid.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; JPO)	OR	ON	ON	2023/03/08 03:59 PM
L1116	46	(Artificial Intelligence) Similar to: 17/873,104 with 0 CPC Selections and 0 Text Selections Text:	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/08 03:59 PM

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L1117	45	(Artificial Intelligence) Similar to: 17/873,104 with 4 CPC Selections and 1 Text Selection	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2023/03/08 03:59 PM