



(12) **United States Patent**
Rutledge

(10) **Patent No.:** **US 6,193,431 B1**
(45) **Date of Patent:** **Feb. 27, 2001**

(54) **FIBERGLASS SUCKER ROD END FITTING**

| | | | | | |
|-----------|---|---------|-------------|-------|-----------|
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(73) Assignee: **The Fiber Composite Company, Inc.**, Big Springs, TX (US)

* cited by examiner

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Primary Examiner—Joanne Silbermann

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(21) Appl. No.: **09/317,353**

(57) **ABSTRACT**

(22) Filed: **May 24, 1999**

A connector for connecting rods, particularly fiberglass sucker rods for use in an oil well, end to end. The connector comprises a rod receptacle having an interior surface shaped to form at least one, but preferably a plurality, of annuluses between the rod and the interior surface of the rod receptacle. The annulus(es) are filled with an initially flowable adhesive which hardens in the annular space(s) to form a wedge or series of axially aligned wedges. The wedge or wedges comprise an annularly thin portion and an annularly thick portion distal to the thin portion. The thick portion of the wedge approaches the rod within the receptacle distal to the thin portion. In the present connector, the thick portion of the wedge or wedges approaches the rod asymptotically.

Related U.S. Application Data

(63) Continuation of application No. 08/936,348, filed on Sep. 24, 1997.

(51) **Int. Cl.⁷** **B25G 3/34**

(52) **U.S. Cl.** **403/268**; 403/265; 403/269

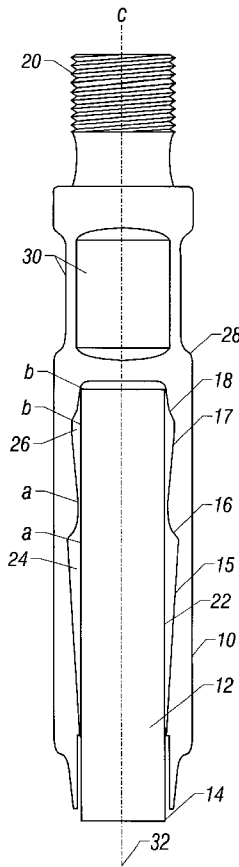
(58) **Field of Search** 403/265, 268, 403/269

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30 Claims, 34 Drawing Sheets



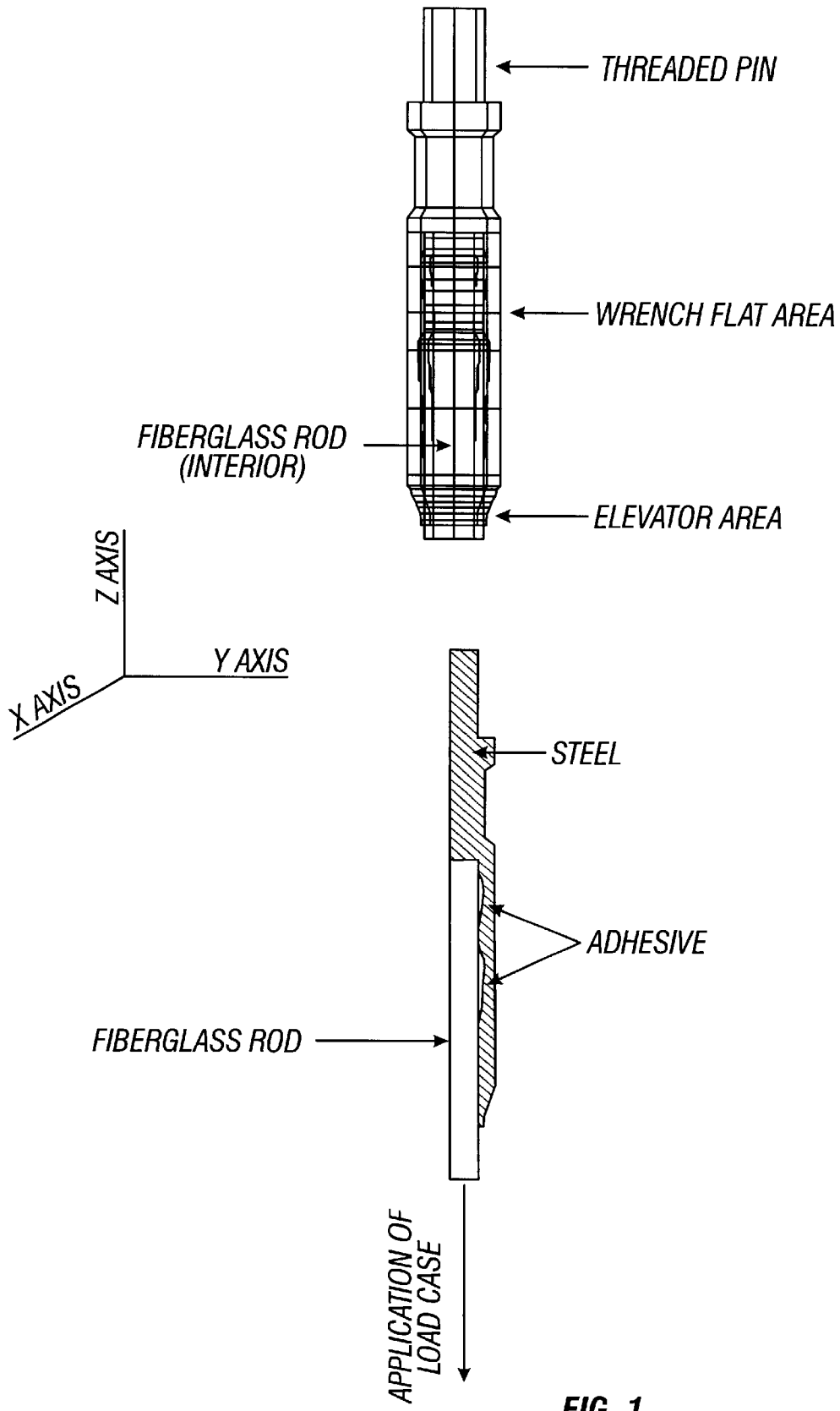


FIG. 1

| | -0.80 | -0.75 | -0.70 | -0.65 | -0.60 | -0.55 | -0.50 | -0.40 | -0.35 | -0.30 | -0.25 | -0.20 | -0.1 |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 7.30 | 830 | 947 | 1130 | 1696 | 4892 | 15409 | 27577 | 13254 | 10998 | 9413 | 8363 | 7704 | 740 |
| 7.20 | 2982 | 3198 | 4317 | 2590 | 8817 | 13359 | 17422 | 18162 | 16016 | 14147 | 12736 | 11685 | 1095 |
| 7.10 | 3402 | 4115 | 5638 | 7750 | 10223 | 12730 | 15261 | 17472 | 17216 | 16491 | 15626 | 14828 | 1418 |
| 7.00 | 3566 | 4376 | 5946 | 8083 | 10476 | 12782 | 14712 | 16914 | 17224 | 17167 | 16894 | 16533 | 1617 |
| 6.90 | 3721 | 4499 | 6165 | 8682 | 11173 | 13141 | 14570 | 16281 | 16707 | 16920 | 16977 | 16935 | 1680 |
| 6.80 | | 4217 | 7485 | 11055 | 12756 | 12963 | 13626 | 14903 | 15385 | 15758 | 16030 | 16219 | 1634 |
| 6.70 | | | | 18716 | 13919 | 13115 | 13360 | 14271 | 14693 | 15051 | 15330 | 15559 | 1571 |
| 6.60 | | | | 15110 | 14990 | 14525 | 14187 | 14282 | 14487 | 14706 | 14909 | 15080 | 1521 |
| 6.50 | | | | 14765 | 14794 | 14722 | 14613 | 14526 | 14572 | 14653 | 14746 | 14836 | 1491 |
| 6.40 | | | | 14666 | 14715 | 14727 | 14711 | 14667 | 14662 | 14671 | 14691 | 14714 | 1473 |
| 6.30 | | | | 14617 | 14678 | 14717 | 14730 | 14704 | 14678 | 14649 | 14622 | 14597 | 1457 |
| 6.20 | | | | 14585 | 14665 | 14714 | 14731 | 14677 | 14618 | 14548 | 14475 | 14404 | 1434 |
| 6.10 | | | | 14577 | 14680 | 14732 | 14731 | 14591 | 14472 | 14338 | 14199 | 14069 | 1395 |
| 6.00 | | | | 14620 | 14751 | 14791 | 14742 | 14431 | 14209 | 13973 | 13740 | 13528 | 1335 |
| 5.90 | | | | 14773 | 14932 | 14926 | 14772 | 14154 | 13773 | 13391 | 13035 | 12724 | 1246 |
| 5.80 | | | | 15155 | 15331 | 15197 | 14813 | 13672 | 13075 | 12525 | 12041 | 11634 | 1131 |
| 5.70 | | | | 16050 | 16191 | 15647 | 14723 | 12809 | 12023 | 11355 | 10795 | 10338 | 998 |
| 5.60 | | | | 18619 | 17994 | 15539 | 13677 | 11472 | 10703 | 10056 | 9510 | 9058 | 8700 |
| 5.50 | | | | 25564 | 15418 | 13323 | 12068 | 10497 | 9830 | 9216 | 8667 | 8201 | 873 |
| 5.40 | 10818 | 8019 | 11690 | 16010 | 14216 | 14216 | 12639 | 10604 | 9740 | 8965 | 8307 | 7783 | 7393 |
| 5.30 | 5196 | 9890 | 12019 | 13831 | 14804 | 14633 | 13707 | 11134 | 9946 | 8989 | 8259 | 7831 | 754 |
| 5.20 | 8332 | 9890 | 12019 | 13664 | 14715 | 15069 | 14528 | 11226 | 9844 | 9067 | 8694 | 8531 | 846 |
| 5.10 | 10874 | 11269 | 12163 | 13181 | 14197 | 15168 | 15182 | 10211 | 10181 | 10389 | 10576 | 10712 | 1081 |
| 5.00 | 12426 | 12548 | 12842 | 13230 | 13784 | 16300 | 18474 | 4908 | 5064 | 5176 | 5245 | 5294 | 5333 |
| 4.90 | 13913 | 13825 | 13974 | 14246 | 14557 | 15110 | 3372 | 4444 | 4798 | 5007 | 5139 | 5227 | 5288 |
| 4.80 | 15055 | 14975 | 15335 | 15716 | 15636 | 13745 | 4113 | 4096 | 4397 | 4645 | 4829 | 4959 | 5044 |
| 4.70 | 15017 | 15547 | 16362 | 17240 | 15965 | 14713 | 3644 | 3958 | 4289 | 4436 | 4570 | 4681 | 4766 |
| 4.60 | 14159 | 15535 | 18058 | 22278 | 25903 | 324 | 3646 | 3961 | 4115 | 4242 | 4347 | 4435 | 4500 |
| 4.50 | 13979 | 15606 | 18729 | 23381 | 26906 | 302 | 3781 | 3922 | 4001 | 4086 | 4165 | 4234 | 4288 |
| 4.40 | 14859 | 15969 | 17155 | 20126 | 21052 | 340 | 3890 | 3881 | 3939 | 3998 | 4052 | 4098 | 4133 |
| 4.30 | 15629 | 15898 | 16682 | 16813 | 16813 | 391 | 3890 | 3942 | 3959 | 3979 | 4002 | 4025 | 4044 |
| 4.20 | 15858 | 15615 | 15379 | 15141 | 14357 | 371 | 3904 | 3977 | 3969 | 3986 | 3974 | 3987 | 4000 |
| 4.10 | 15609 | 15157 | 14736 | 13742 | 12896 | 4268 | 4268 | 3911 | 3924 | 3952 | 3972 | 3986 | 3999 |
| 4.00 | 15261 | 14717 | 14127 | 13748 | 12759 | 11648 | 3945 | 4125 | 4066 | 4049 | 4039 | 4032 | 4021 |
| 3.90 | 15026 | 14411 | 13687 | 12869 | 11973 | 10738 | 3912 | 4118 | 4138 | 4118 | 4092 | 4069 | 4055 |
| 3.80 | 15037 | 14311 | 13429 | 12429 | 11345 | 9941 | 4118 | 4134 | 4117 | 4089 | 4078 | 4058 | 4044 |

(A)

(B)

(C)

(D)

FIG.

| | 0.00 | 0.5 | 0.10 | 0.15 | 0.20 | 0.25 | 0.30 | 0.35 | 0.40 | 0.45 | 0.50 | 0.55 | 0.60 | -0.60 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ⓜ | 10597 | 9297 | 7569 | 7405 | 7704 | 8363 | 9413 | 10998 | 13254 | 20025 | 27577 | 15409 | 4892 | 16992 |
| | 11728 | 11078 | 10553 | 10950 | 11685 | 12736 | 14147 | 16016 | 18162 | 19174 | 17422 | 13359 | 8817 | 25992 |
| | 13719 | 13693 | 13733 | 14181 | 14828 | 15626 | 16491 | 17216 | 17472 | 16887 | 15261 | 12730 | 10223 | 77550 |
| | 15576 | 15734 | 15889 | 16178 | 16533 | 16894 | 17167 | 17224 | 16914 | 16101 | 14712 | 12782 | 10476 | 80878 |
| | 16536 | 16657 | 16743 | 16802 | 16935 | 16977 | 16920 | 16707 | 16281 | 15589 | 14570 | 13141 | 11173 | 86888 |
| | 16606 | 16647 | 16649 | 16341 | 16219 | 16030 | 15758 | 15385 | 14903 | 14313 | 13626 | 12963 | 12756 | 11055 |
| | 15912 | 15880 | 15824 | 15719 | 15559 | 15330 | 15051 | 14693 | 14271 | 13807 | 13360 | 13115 | 13919 | 18711 |
| | 15640 | 15365 | 15310 | 15215 | 15080 | 14909 | 14706 | 14487 | 14282 | 14148 | 14187 | 14525 | 14990 | 15117 |
| | 15198 | 15187 | 14970 | 14913 | 14836 | 14746 | 14653 | 14572 | 14526 | 14537 | 14613 | 14722 | 14794 | 14766 |
| | 14778 | 14769 | 14754 | 14736 | 14714 | 14691 | 14671 | 14662 | 14667 | 14686 | 14711 | 14727 | 14715 | 14666 |
| | 14550 | 14556 | 14561 | 14576 | 14597 | 14622 | 14649 | 14678 | 14704 | 14724 | 14730 | 14717 | 14678 | 14611 |
| | 14255 | 14273 | 14294 | 14342 | 14404 | 14475 | 14548 | 14618 | 14677 | 14717 | 14731 | 14714 | 14665 | 14588 |
| | 13809 | 13835 | 13870 | 13956 | 14069 | 14199 | 14338 | 14472 | 14591 | 14681 | 14731 | 14732 | 14680 | 14577 |
| | 13153 | 13175 | 13217 | 13350 | 13528 | 13740 | 13973 | 14209 | 14431 | 14651 | 14742 | 14791 | 14751 | 14622 |
| | 12661 | 12255 | 12288 | 12469 | 12724 | 13035 | 13391 | 13773 | 14154 | 14500 | 14772 | 14926 | 14932 | 14773 |
| | 11169 | 11100 | 11095 | 11314 | 11634 | 12041 | 12525 | 13075 | 13672 | 14274 | 14813 | 15197 | 15331 | 15151 |
| | 9980 | 9820 | 9755 | 9985 | 10338 | 10795 | 11355 | 12023 | 12809 | 13720 | 14723 | 15647 | 16191 | 16055 |
| | 8828 | 8594 | 8484 | 8708 | 9058 | 9510 | 10056 | 10703 | 11472 | 12422 | 13677 | 15539 | 17994 | 18619 |
| | 7882 | 7626 | 7596 | 8737 | 8201 | 8667 | 9216 | 9830 | 10497 | 11224 | 12068 | 13323 | 15418 | 25566 |
| | 7103 | 7064 | 7150 | 7399 | 7783 | 8307 | 8965 | 9740 | 10604 | 11556 | 12639 | 14216 | 14216 | 16010 |
| | 7408 | 7324 | 7380 | 7542 | 7831 | 8259 | 8989 | 9946 | 11134 | 12446 | 13707 | 14633 | 14804 | 13833 |
| | 9071 | 8743 | 8472 | 8467 | 8531 | 8694 | 9067 | 9844 | 11226 | 13045 | 14528 | 15069 | 14715 | 13666 |
| Ⓛ | 11438 | 11162 | 10907 | 10810 | 10712 | 10576 | 10389 | 10181 | 10211 | 11627 | 15182 | 15168 | 14197 | 13181 |
| | 5400 | 5387 | 5362 | 5330 | 5294 | 5245 | 5176 | 5064 | 4908 | 4234 | 18474 | 16300 | 13784 | 13230 |
| | 5338 | 5336 | 5321 | 5286 | 5227 | 5139 | 5007 | 4798 | 4444 | 3817 | 3312 | 15110 | 14557 | 14246 |
| | 5156 | 5139 | 5105 | 5048 | 4959 | 4829 | 4645 | 4397 | 4096 | 3785 | 4113 | 13745 | 15636 | 15716 |
| | 4889 | 4865 | 4826 | 4766 | 4681 | 4570 | 4436 | 4289 | 3958 | 3881 | 3644 | 14713 | 15965 | 17240 |
| | 4612 | 4590 | 4555 | 4505 | 4435 | 4347 | 4242 | 4115 | 3961 | 3755 | 3646 | 324 | 25903 | 22278 |
| | 4373 | 4355 | 4329 | 4289 | 4234 | 4165 | 4086 | 4001 | 3922 | 3833 | 3781 | 302 | 26906 | 23388 |
| | 4195 | 4183 | 4165 | 4137 | 4098 | 4052 | 3998 | 3939 | 3881 | 3865 | 3890 | 340 | 21052 | 20122 |
| | 4081 | 4073 | 4063 | 4046 | 4025 | 4002 | 3979 | 3959 | 3942 | 3918 | 3890 | 391 | 16813 | 16842 |
| | 4022 | 4017 | 4010 | 4000 | 3987 | 3974 | 3986 | 3969 | 3977 | 3935 | 3904 | 371 | 14357 | 15147 |
| | 4008 | 4004 | 4001 | 3995 | 3986 | 3972 | 3952 | 3924 | 3911 | 4053 | 4268 | 12493 | 12896 | 13742 |
| | 4019 | 4020 | 4022 | 4026 | 4032 | 4039 | 4049 | 4066 | 4125 | 4083 | 3945 | 11648 | 12759 | 13748 |
| | 4029 | 4033 | 4040 | 4052 | 4069 | 4092 | 4118 | 4138 | 4118 | 3996 | 3912 | 10738 | 11973 | 12869 |
| | 4025 | 4027 | 4032 | 4043 | 4058 | 4078 | 4089 | 4117 | 4134 | 4163 | 4118 | 9941 | 11345 | 12429 |

Ⓛ Ⓜ

FIG

Page

| | | | | | | | | | | | | | | |
|-----|------|-------|-------|-------|-------|-------|-------|------|-----|------|------|------|------|------|
| (A) | 3.70 | 15380 | 14457 | 13391 | 21181 | 10867 | 9099 | 4396 | (C) | 4191 | 4121 | 4077 | 4050 | 4034 |
| | 3.60 | 16076 | 14896 | 13602 | 12170 | 10586 | 8299 | 4702 | (D) | 4204 | 4114 | 4073 | 4050 | 4050 |
| | 3.50 | 17025 | 15580 | 14145 | 12563 | 10727 | 7764 | 6251 | | 4168 | 4168 | 4162 | 4154 | 4147 |
| | 3.40 | 17869 | 16469 | 15270 | 1371 | 11933 | 8614 | 3088 | | 4479 | 4392 | 4340 | 4307 | 4285 |
| | 3.30 | 17848 | 17285 | 16921 | 15851 | 12873 | 850 | 4394 | | 4335 | 4386 | 4388 | 4378 | 4367 |
| | 3.20 | 16533 | 17691 | 18765 | 20185 | 523 | 497 | 4011 | | 4266 | 4307 | 4336 | 4354 | 4364 |
| | 3.10 | 15549 | 17819 | 20680 | 26261 | 350 | 2052 | 3881 | | 4093 | 4207 | 4254 | 4285 | 4307 |
| | 3.00 | 16474 | 18551 | 20860 | 24212 | 351 | 2092 | 3893 | | 4056 | 4119 | 4167 | 4204 | 4231 |
| | 2.90 | 17779 | 18831 | 20059 | 22064 | 363 | 2172 | 3972 | | 4035 | 4075 | 4111 | 4142 | 4167 |
| | 2.80 | 18347 | 18540 | 18902 | 19180 | 375 | 2218 | 4052 | | 4064 | 4079 | 4098 | 4116 | 4132 |
| | 2.70 | 18278 | 1800 | 17840 | 17466 | 386 | 386 | 4123 | | 4108 | 4108 | 4113 | 4120 | 4127 |
| | 2.60 | 17840 | 17376 | 16988 | 16221 | 15767 | 394 | 2305 | | 4155 | 4149 | 4145 | 4144 | 4143 |
| | 2.50 | 17207 | 16728 | 16262 | 15621 | 15397 | 398 | 2309 | | 4211 | 4198 | 4187 | 4178 | 4171 |
| | 2.40 | 16541 | 16146 | 15736 | 15358 | 15018 | 398 | 2347 | | 4261 | 4243 | 4226 | 4211 | 7199 |
| | 2.30 | 15969 | 15703 | 15418 | 15122 | 14626 | 405 | 4346 | | 4298 | 4272 | 4249 | 4233 | 4222 |
| | 2.20 | 15482 | 15263 | 15020 | 14749 | 14300 | 418 | 4437 | | 4311 | 4278 | 4262 | 4254 | 4248 |
| | 2.10 | 15062 | 14886 | 14681 | 14444 | 14103 | 424 | 2739 | | 4302 | 4306 | 4303 | 4297 | 4291 |
| | 2.00 | 14708 | 14572 | 14406 | 14221 | 13917 | 13734 | 2212 | | 4405 | 4389 | 4371 | 4355 | 4342 |
| | 1.90 | 14425 | 14314 | 14170 | 14013 | 13805 | 13691 | 2363 | | 4387 | 4399 | 4393 | 4382 | 4369 |
| | 1.80 | 14213 | 14111 | 13989 | 13847 | 13640 | 13543 | 2421 | | 4405 | 4398 | 4391 | 4382 | 4374 |
| | 1.70 | 14046 | 13952 | 13871 | 13793 | 13610 | 13625 | 4350 | | 4442 | 4419 | 4404 | 4395 | 4389 |
| | 1.60 | 13863 | 13797 | 13729 | 13663 | 13591 | 13555 | 2508 | | 4501 | 4469 | 4452 | 4446 | 4448 |
| | 1.50 | 13703 | 13649 | 13606 | 13574 | 13550 | 13565 | 2581 | | 4575 | 4550 | 4553 | 4570 | 4591 |
| | 1.40 | 13538 | 13499 | 13506 | 13550 | 13685 | 13688 | 2212 | | 4666 | 4732 | 4781 | 4826 | 4886 |
| | 1.30 | 13306 | 13296 | 13365 | 13494 | 13635 | 13838 | 4266 | | 5022 | 5097 | 5161 | 5225 | 5282 |
| | 1.20 | 12951 | 13003 | 13197 | 13473 | 13783 | 14261 | 4794 | | 5289 | 5456 | 5601 | 5727 | 5836 |
| | 1.10 | 12337 | 12573 | 13084 | 13670 | 14181 | 14638 | 5392 | | 5746 | 5967 | 6197 | 6407 | 6582 |
| | 1.00 | 11143 | 11859 | 13014 | 14267 | 15145 | 15095 | 5909 | | 6383 | 6808 | 7157 | 7420 | 7620 |

FIG. 2C

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