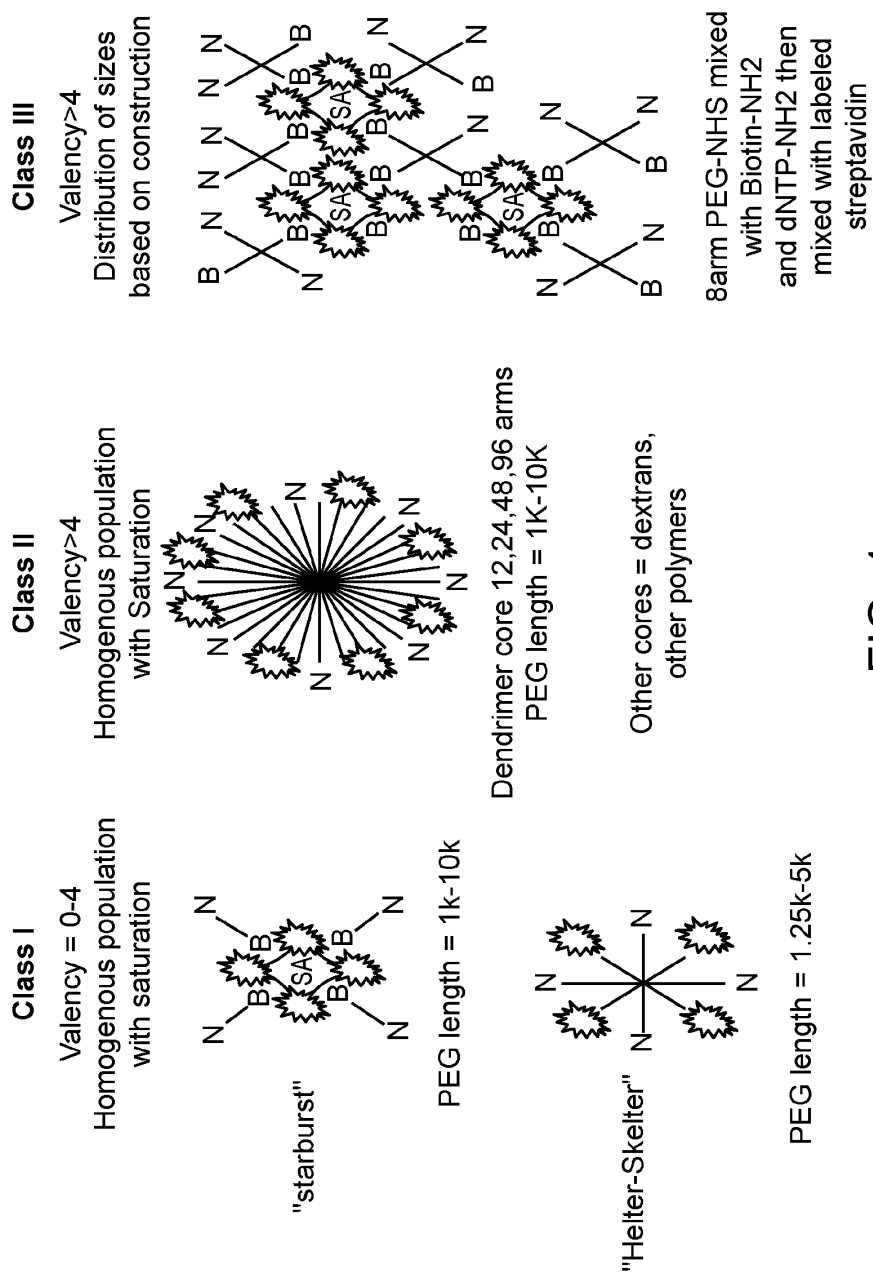




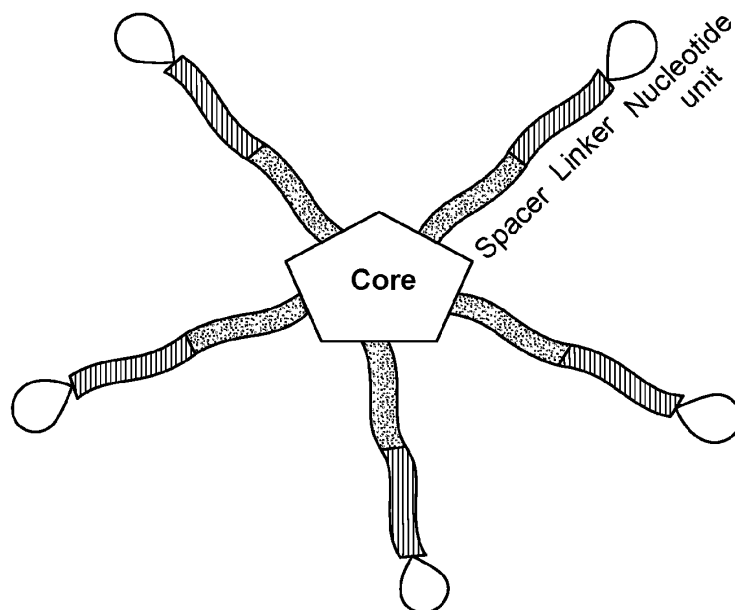


FIG. 2

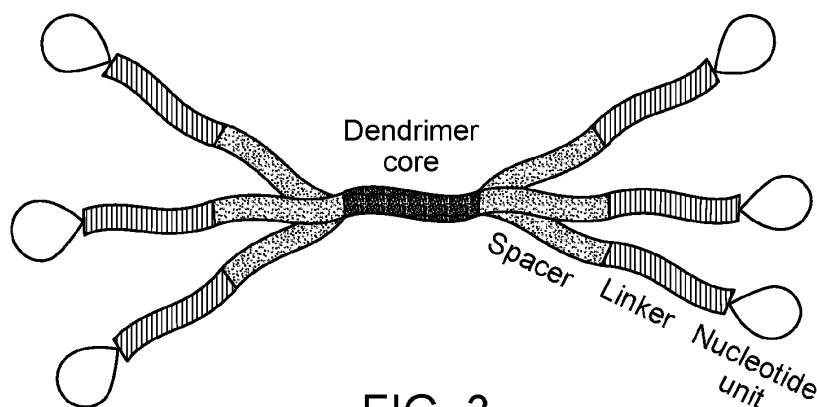


FIG. 3

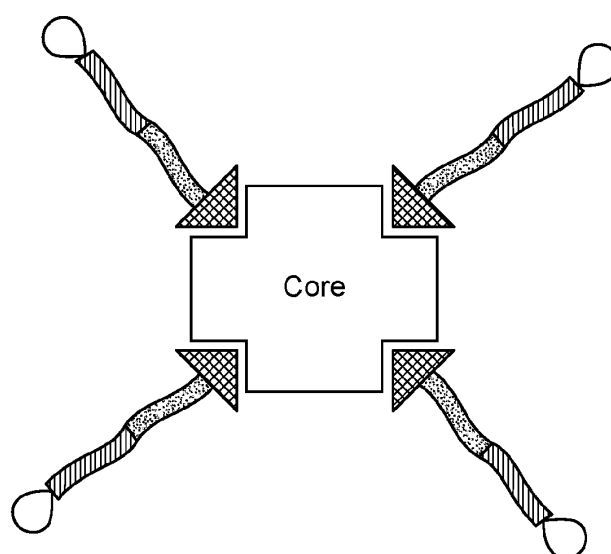


FIG. 4

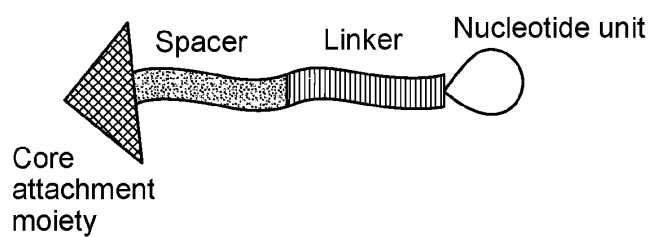
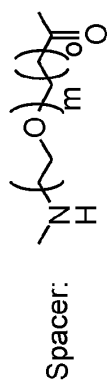


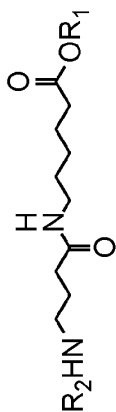
FIG. 5

**Linkers:**

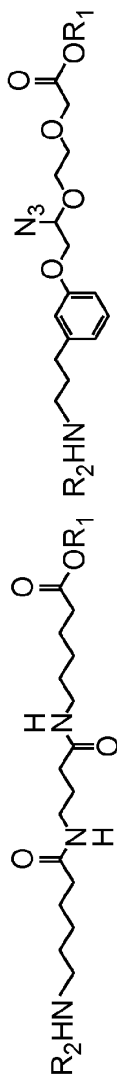
11 atom Linker:



16 atom Linker:



23 atom Linker:



N3 Linker:

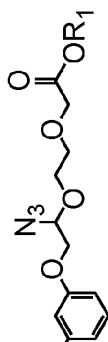


FIG. 6

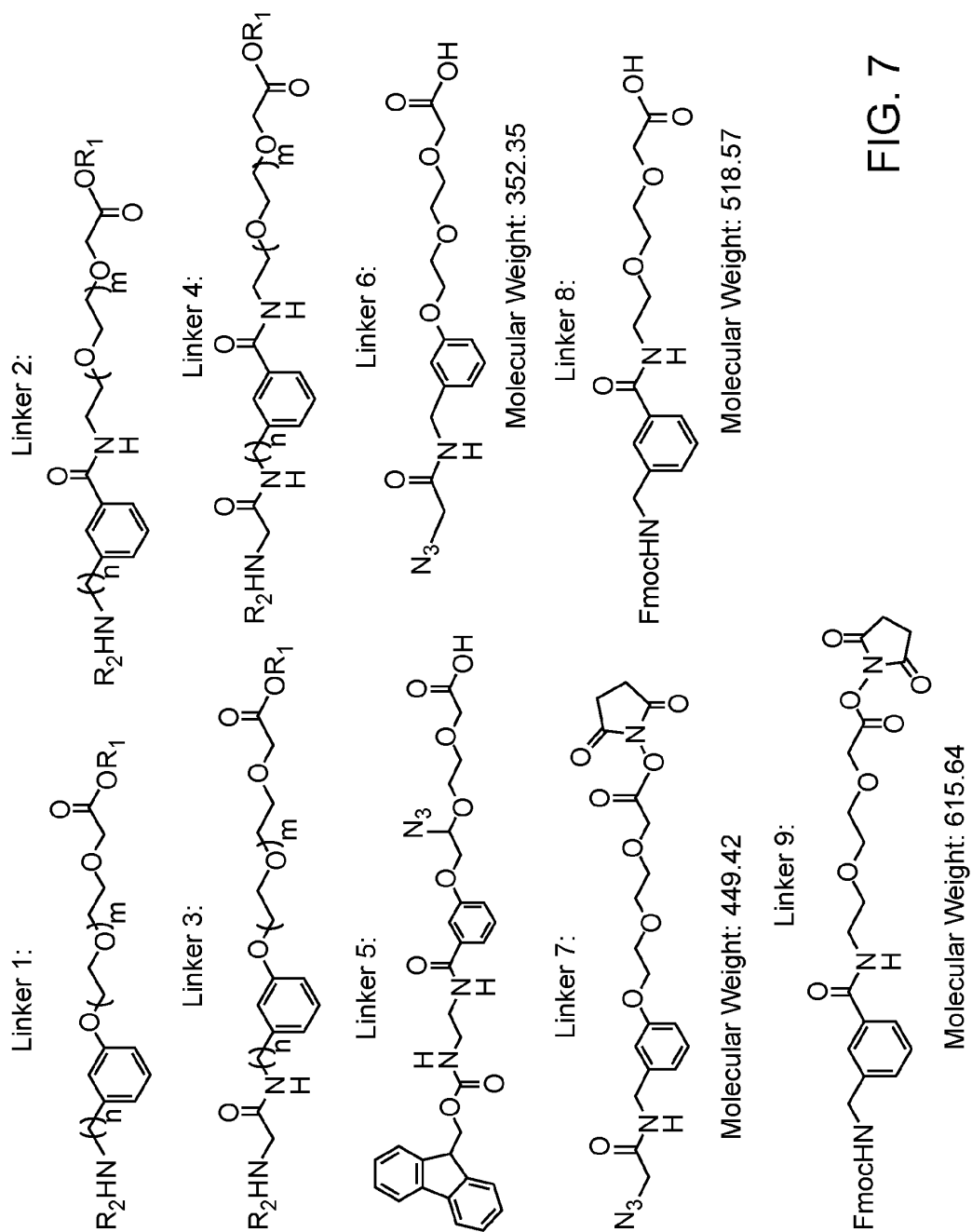


FIG. 7

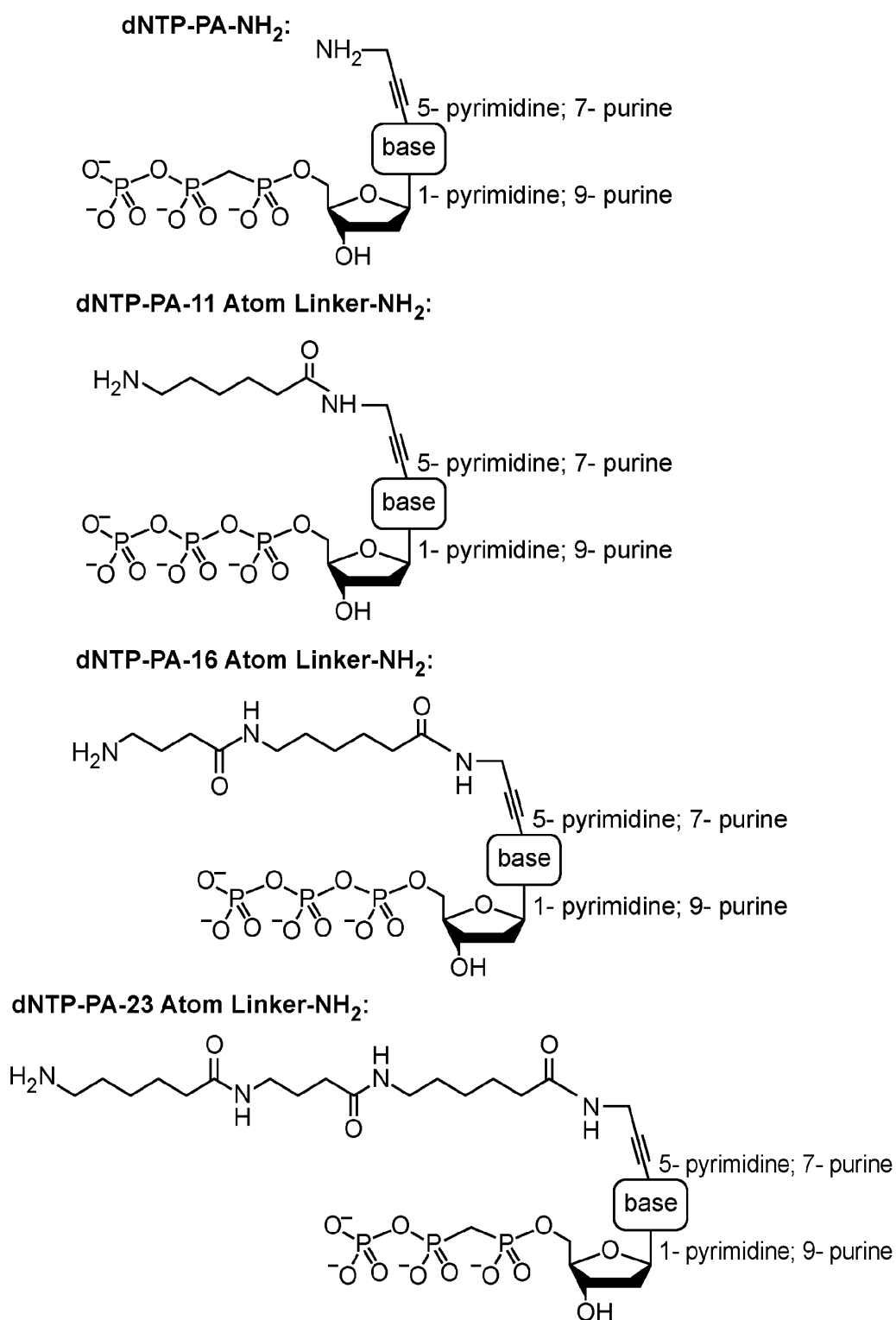


FIG. 8

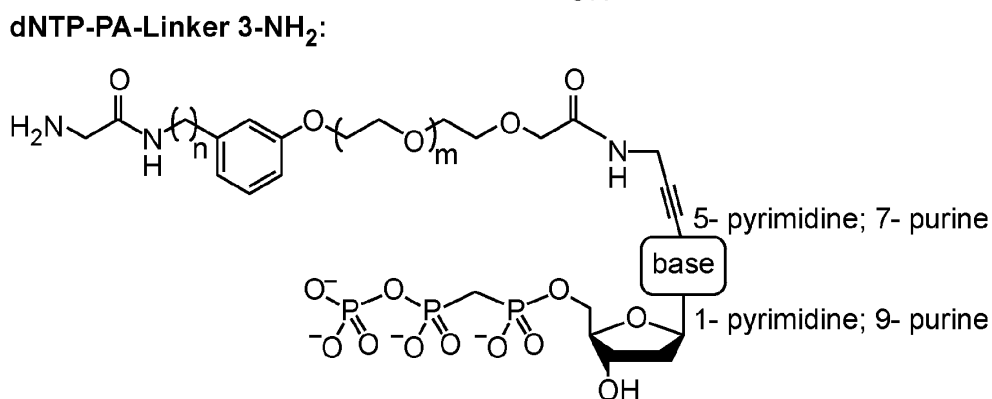
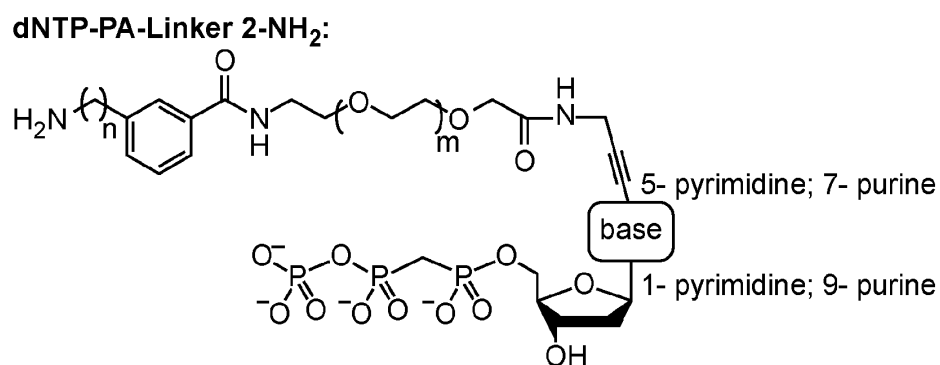
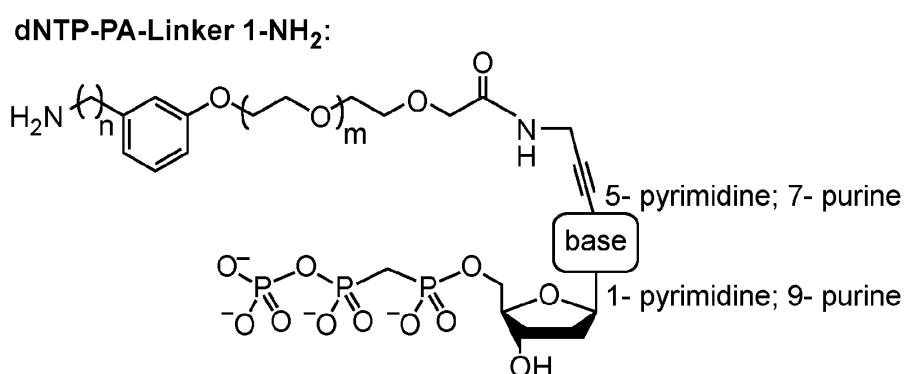
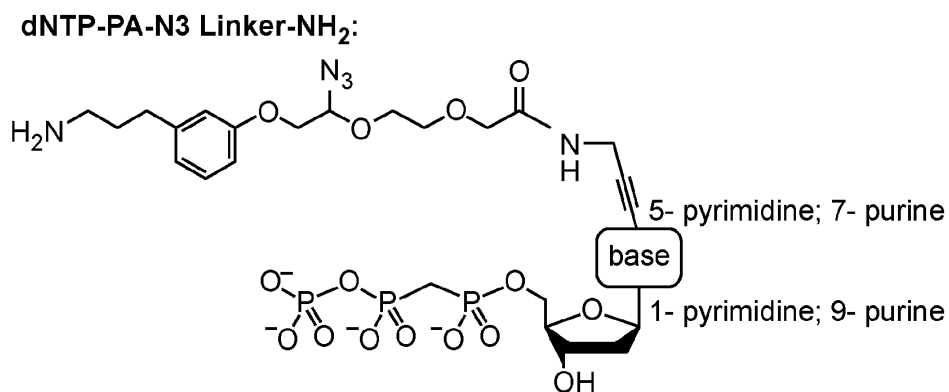


FIG. 9

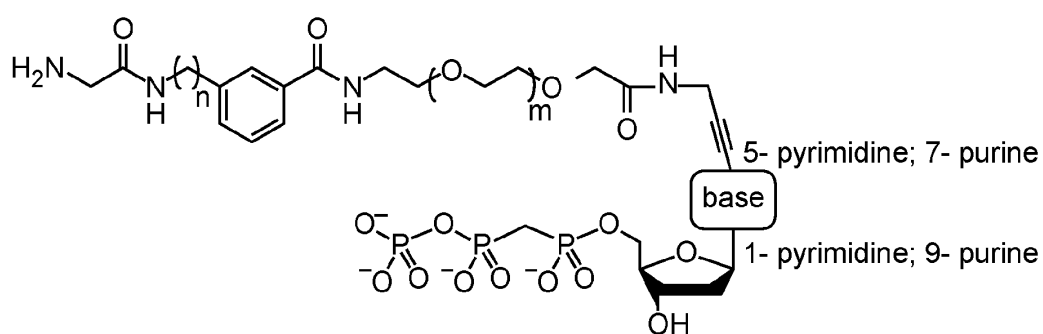
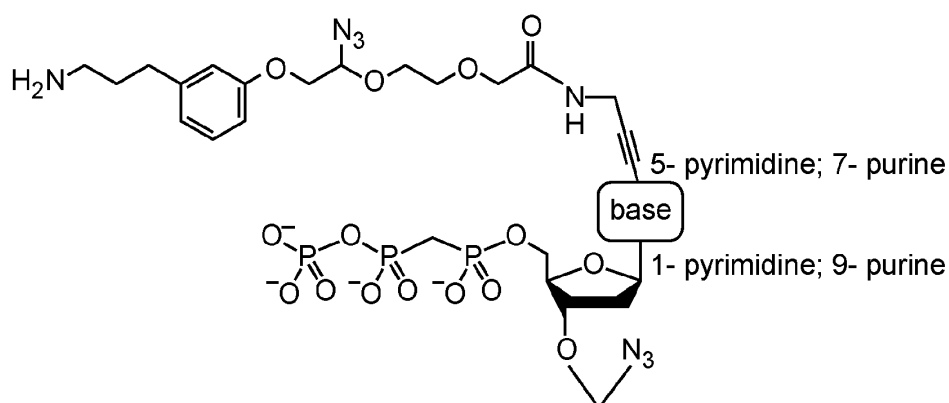
dNTP-PA-Linker 4-NH₂:**dNTP-PA-N3 Linker-NH₂:**

FIG. 10

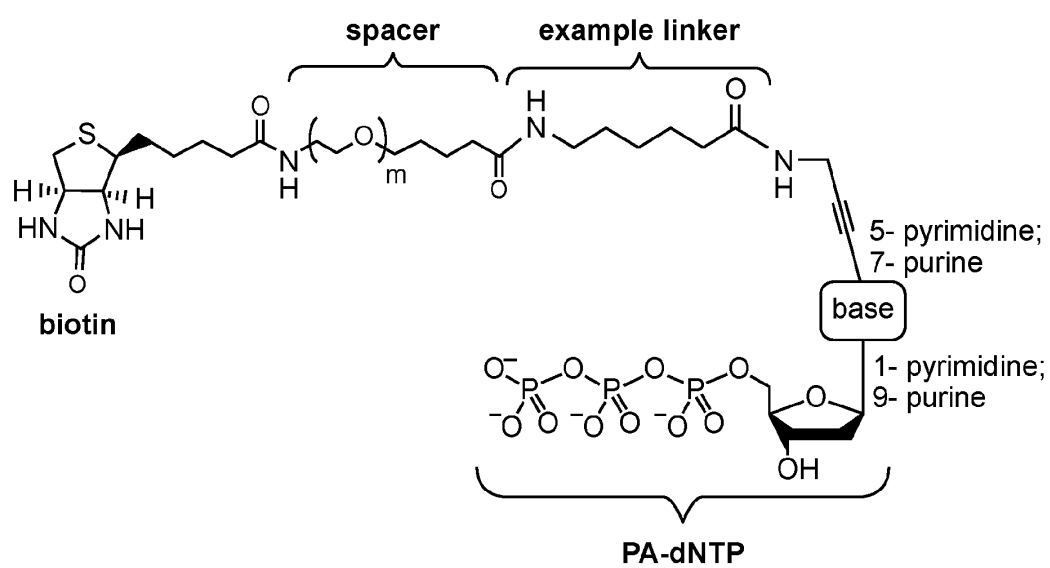
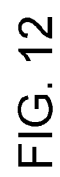
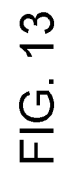


FIG. 11



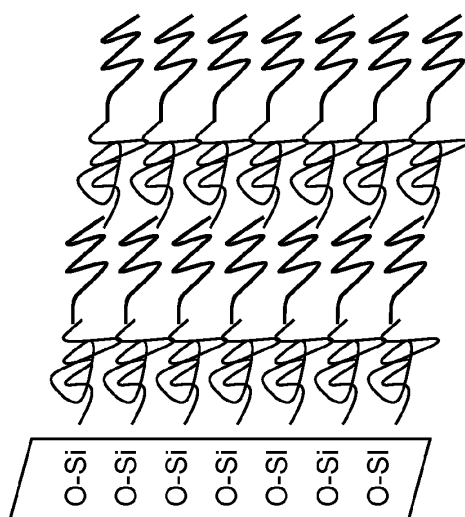


FIG. 14

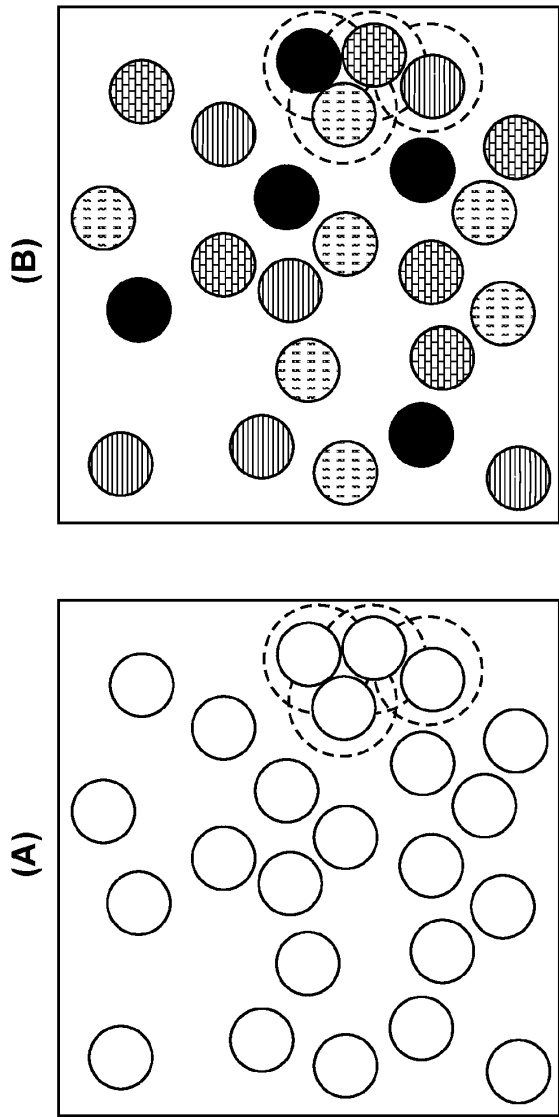


FIG. 15

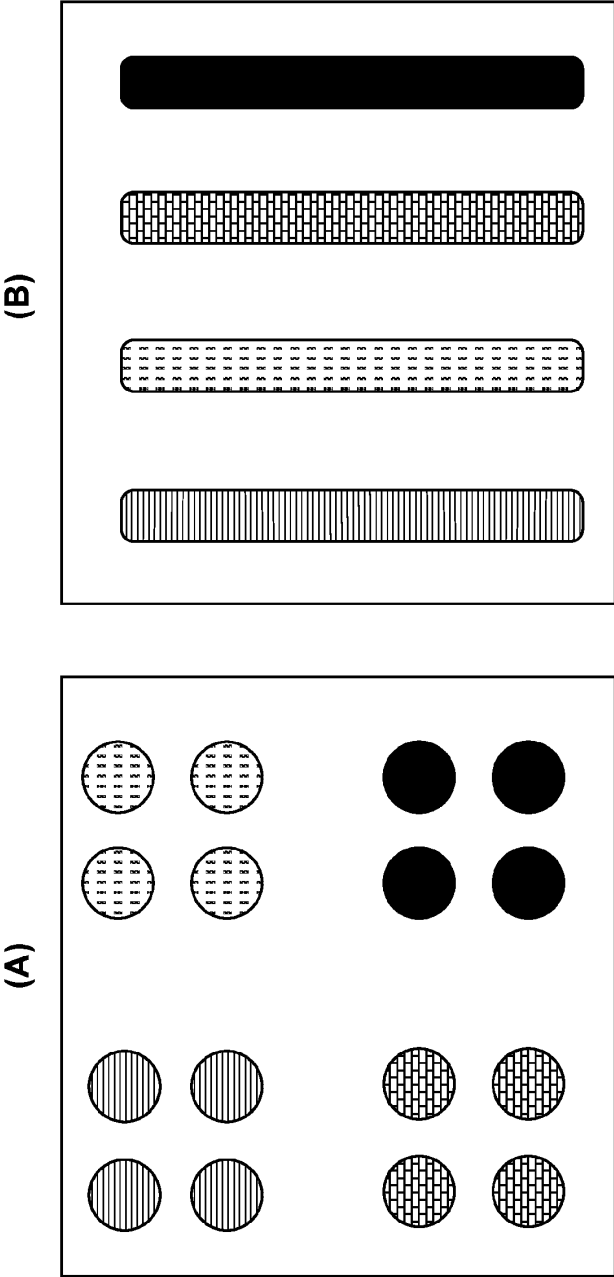


FIG. 16

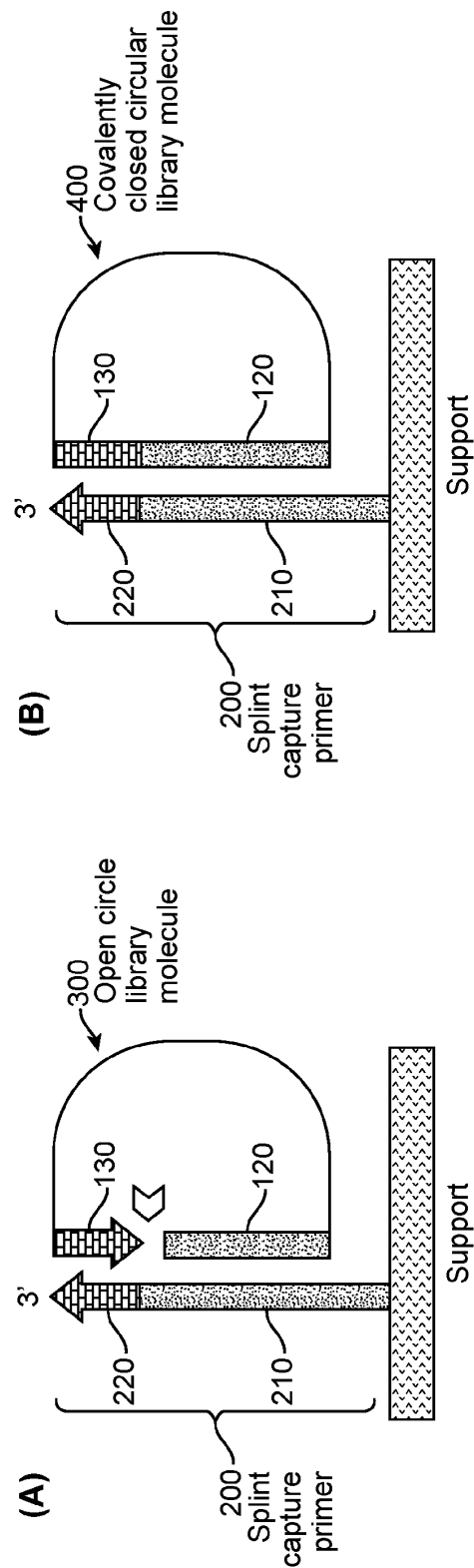


FIG. 17

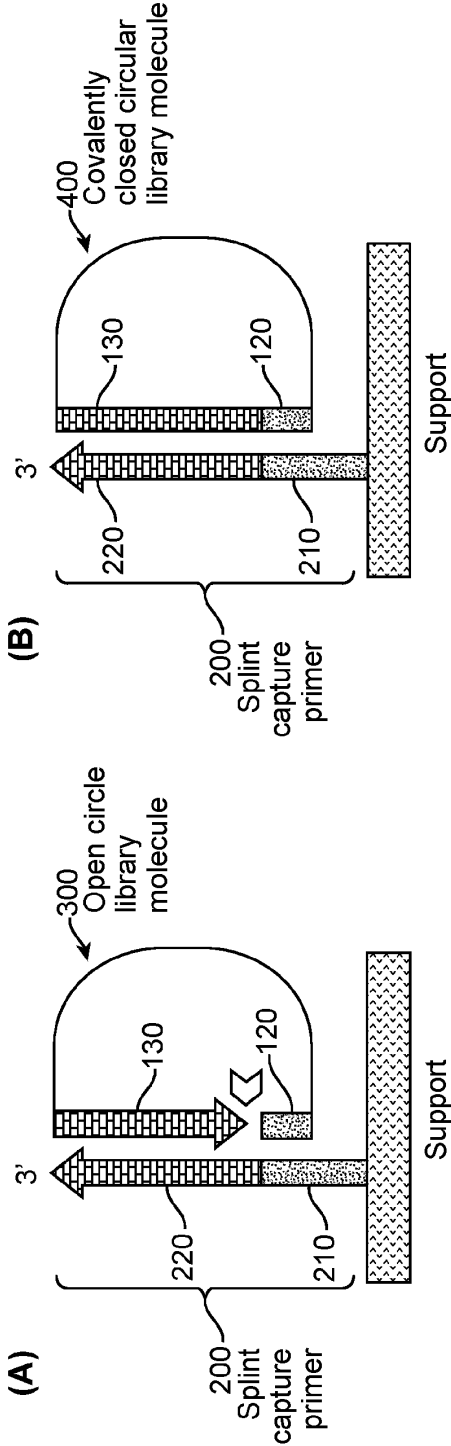


FIG. 18

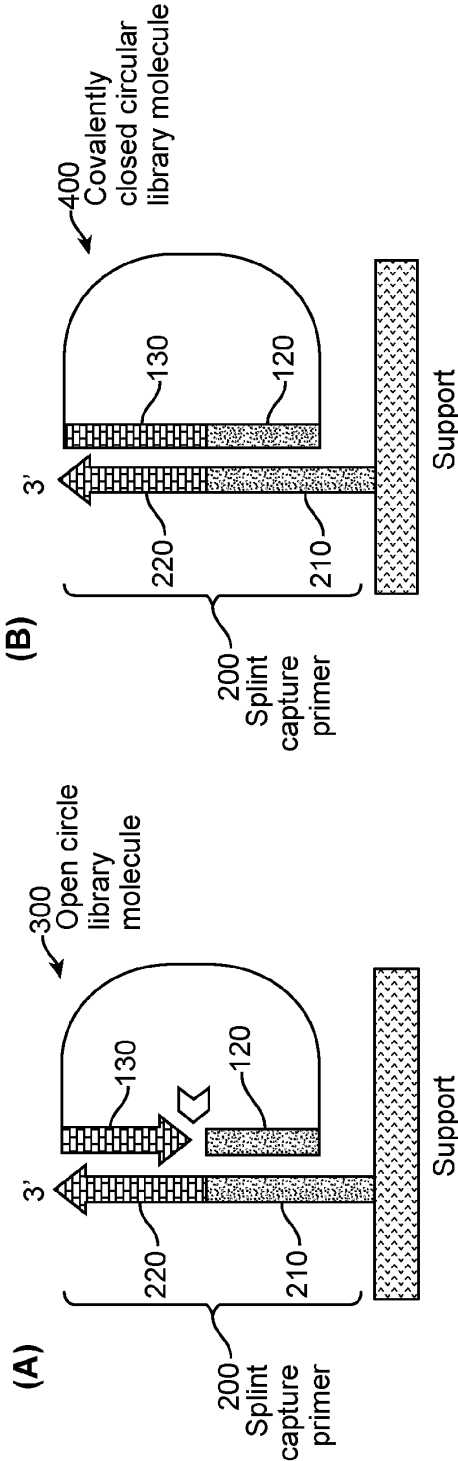


FIG. 19

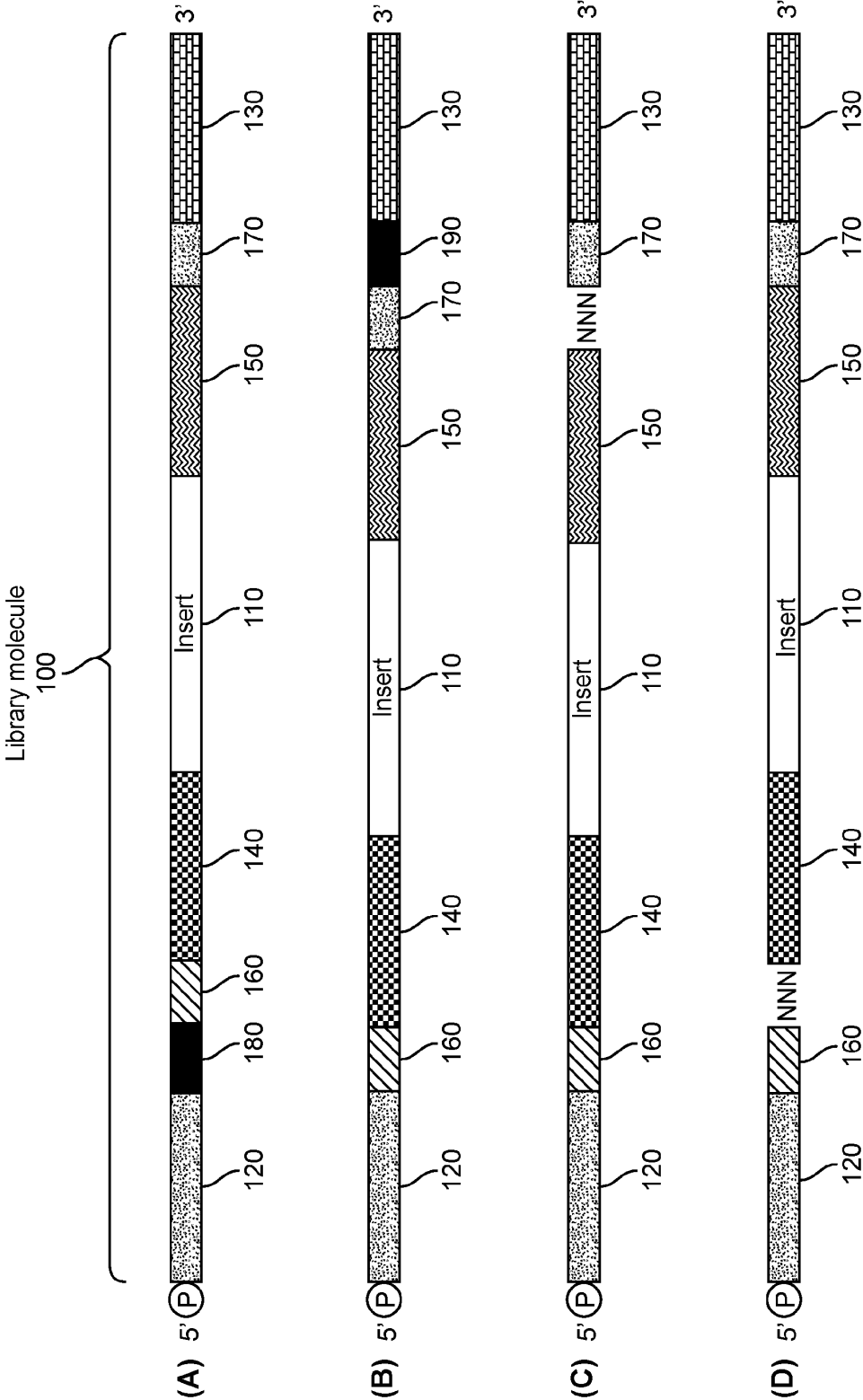


FIG. 20

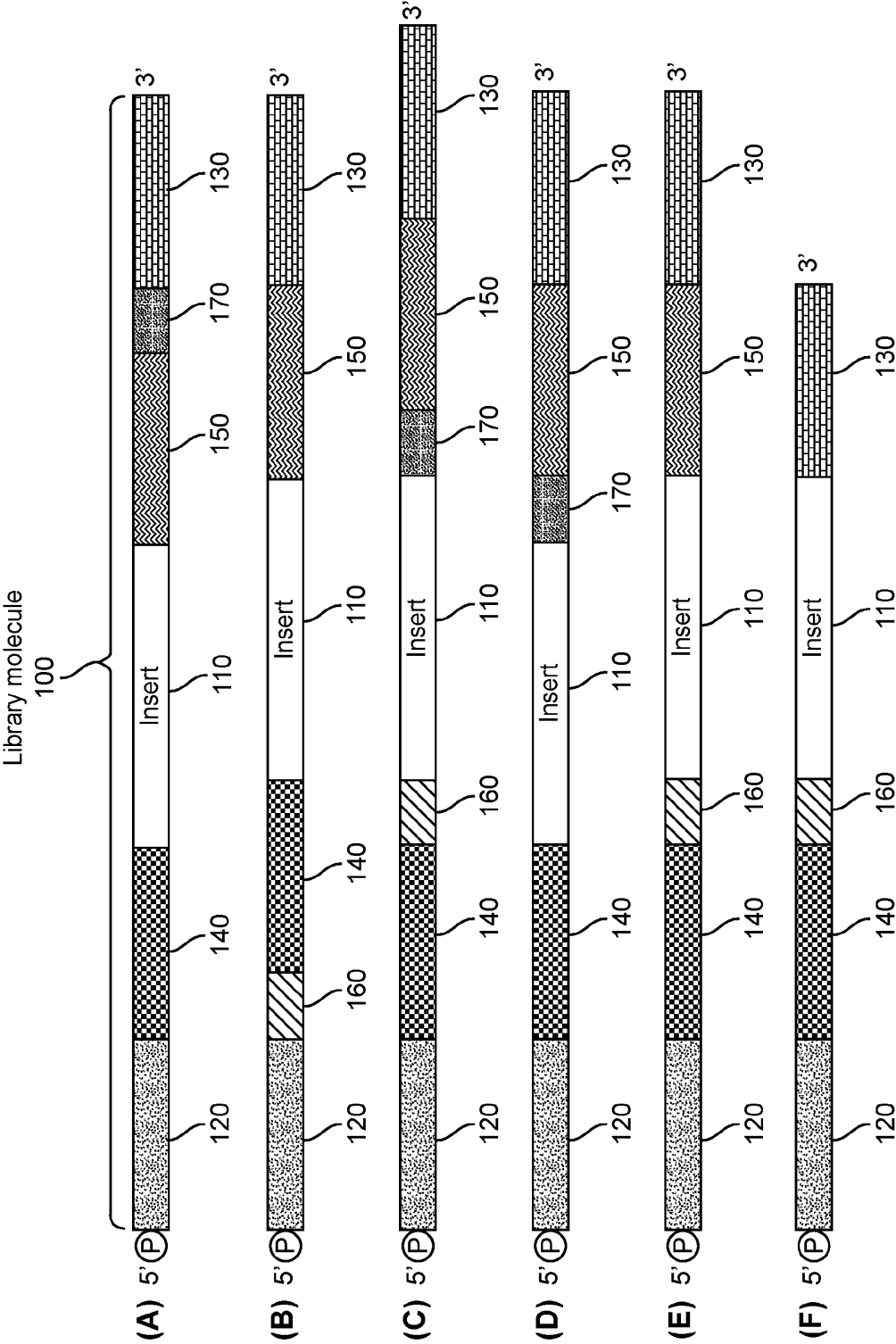


FIG. 21

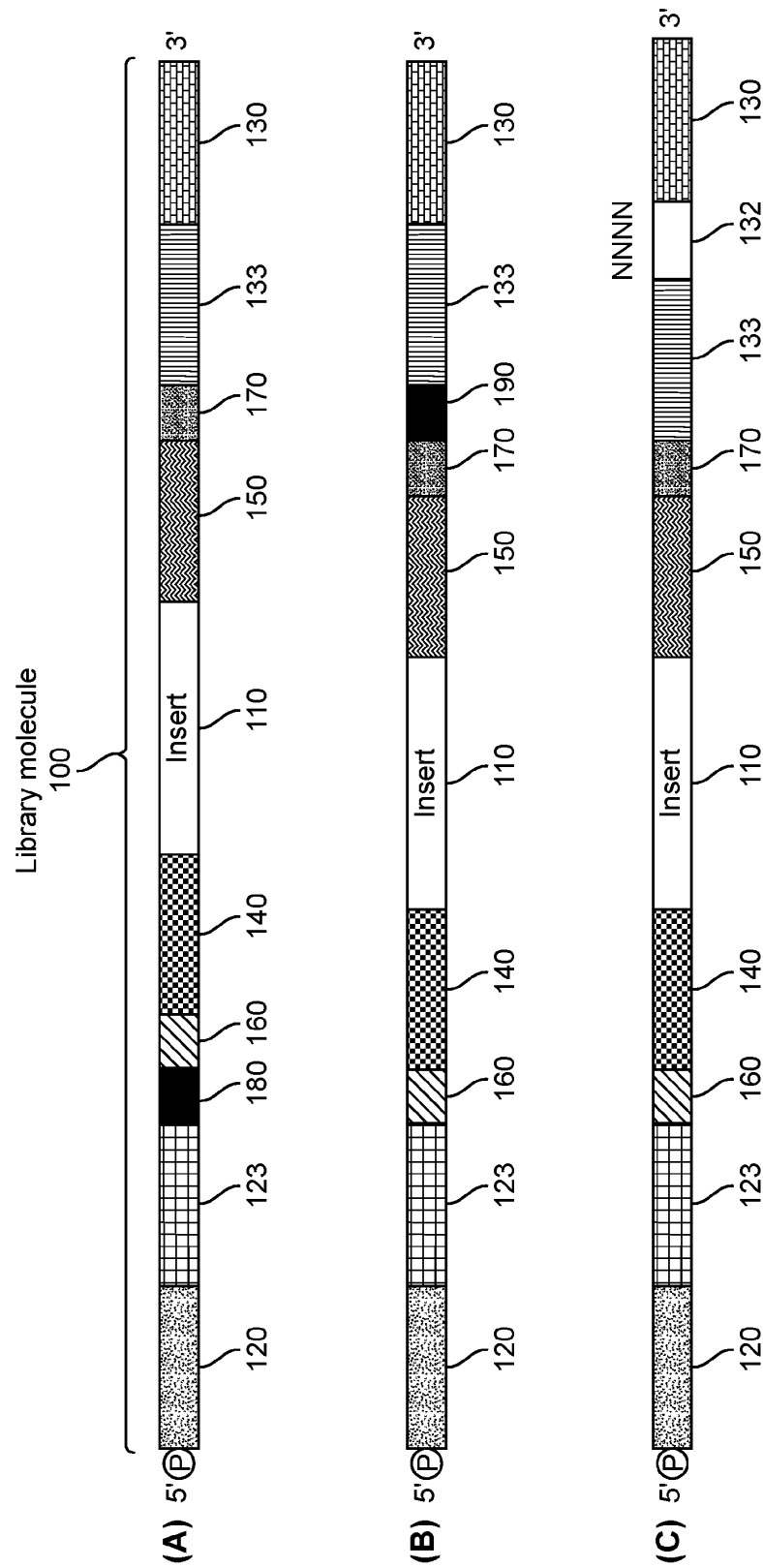


FIG. 22

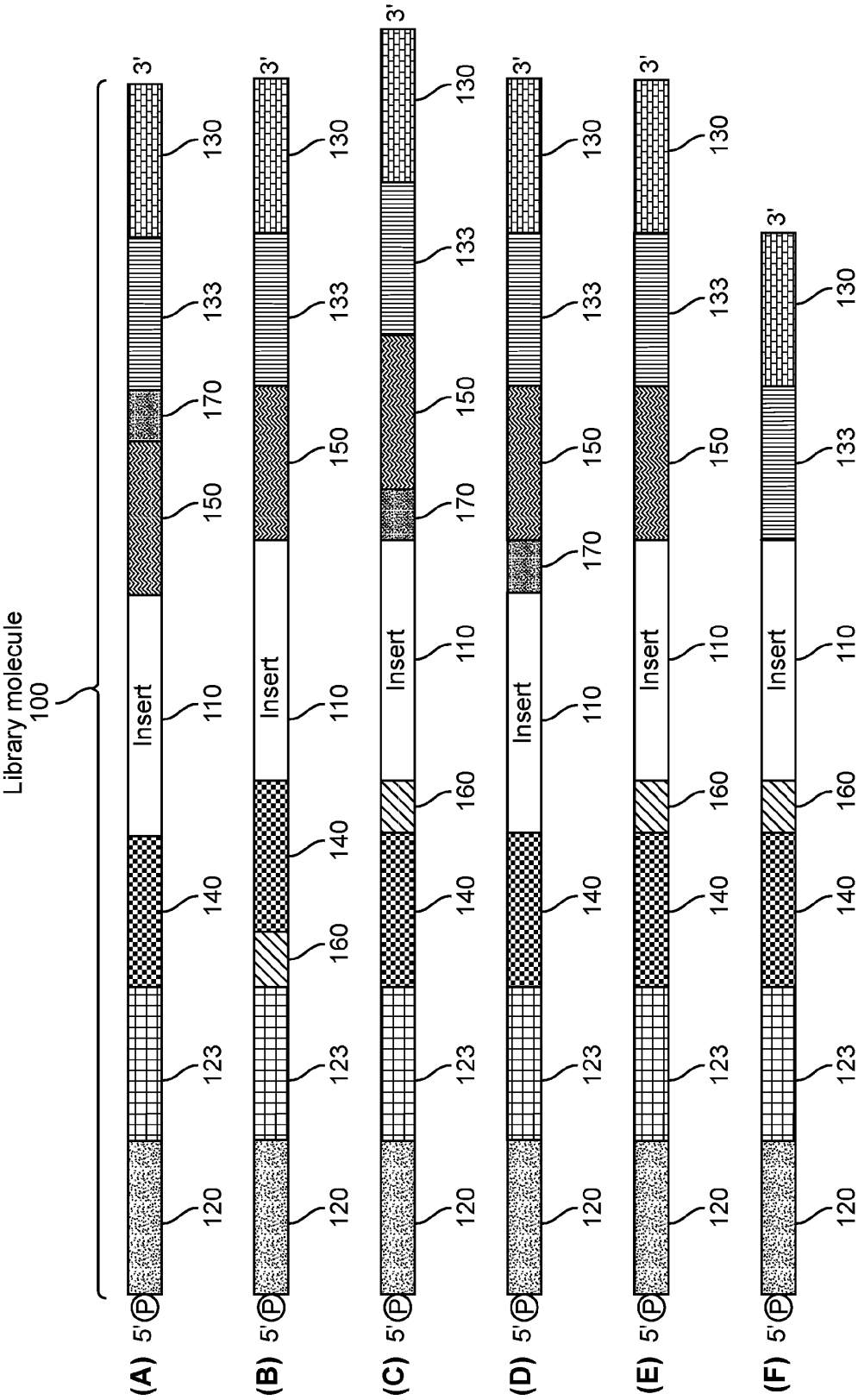


FIG. 23

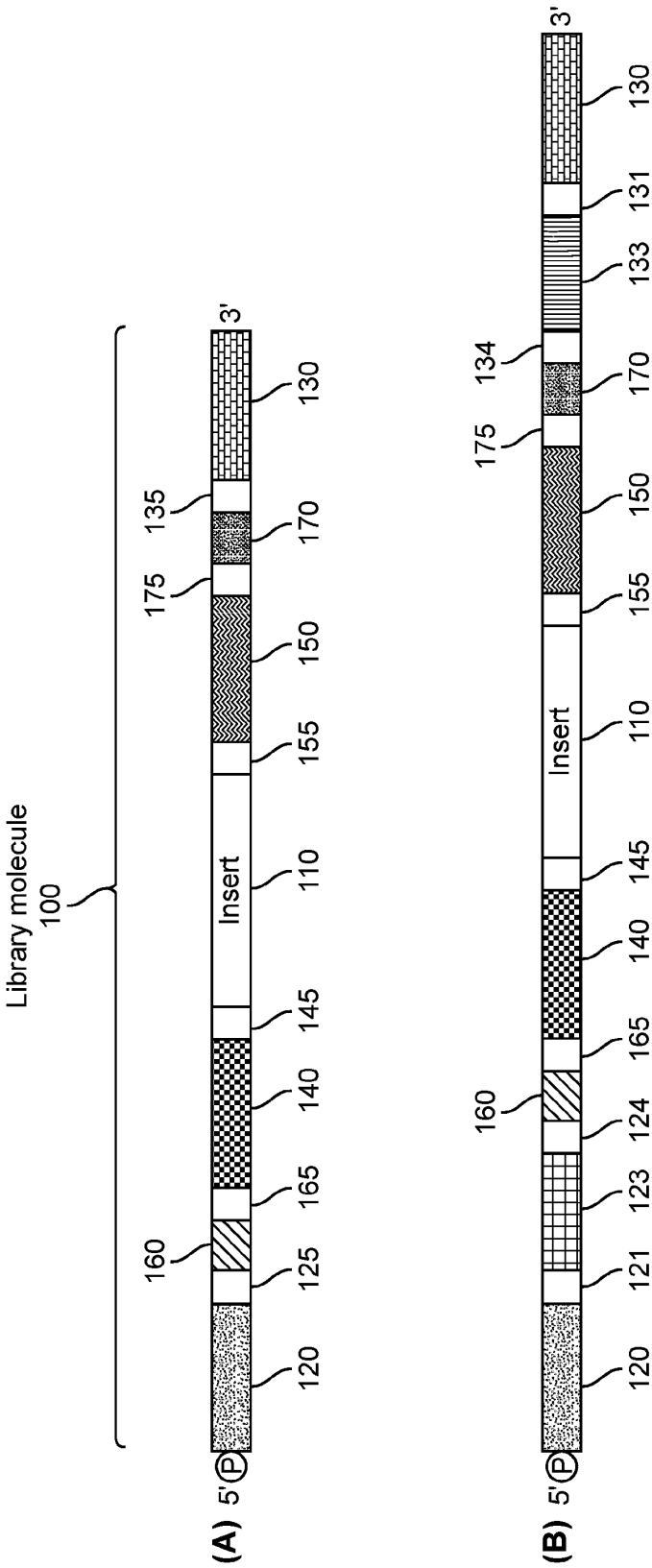


FIG. 24

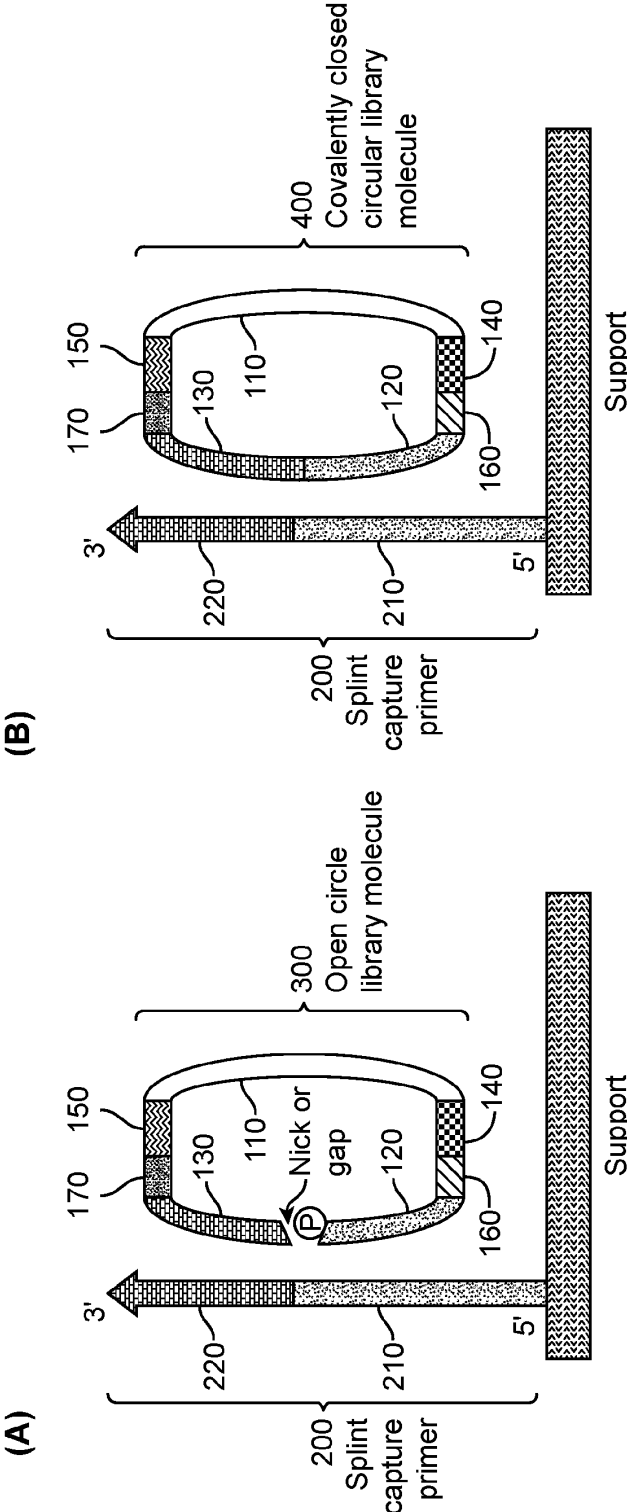


FIG. 25

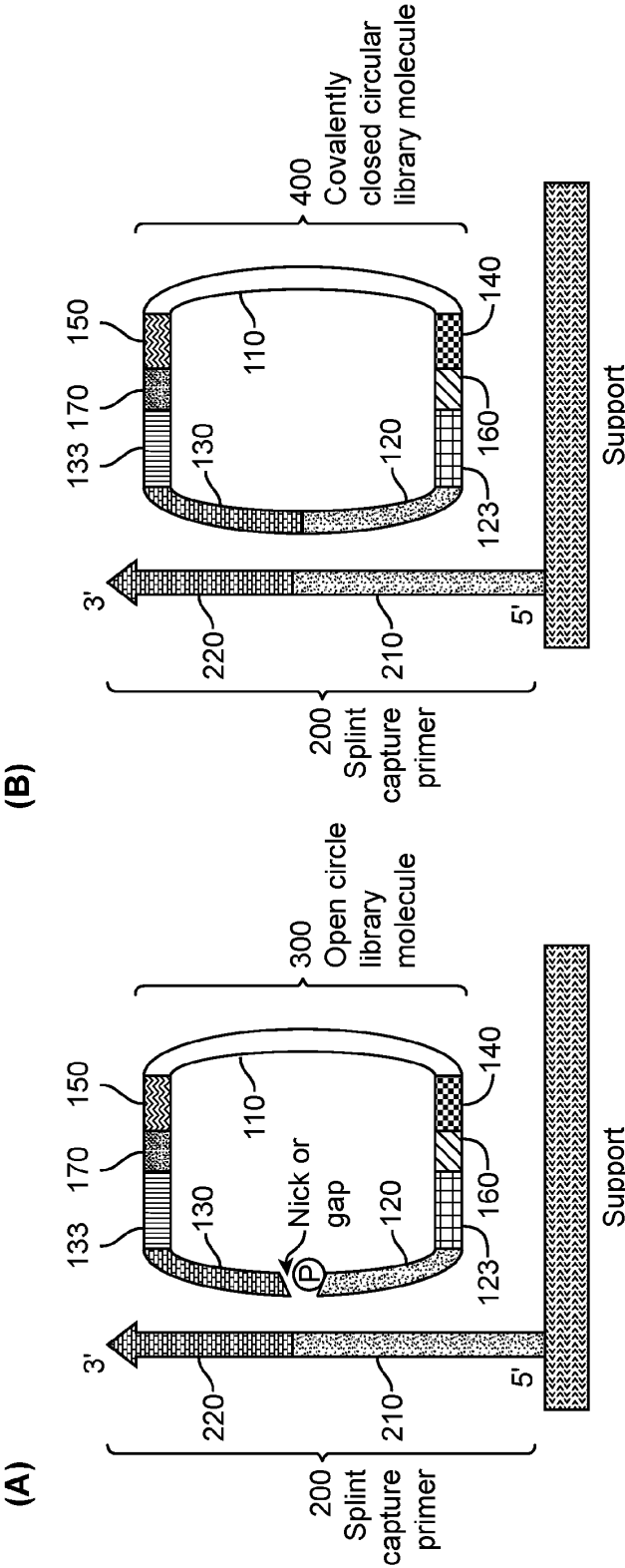


FIG. 26

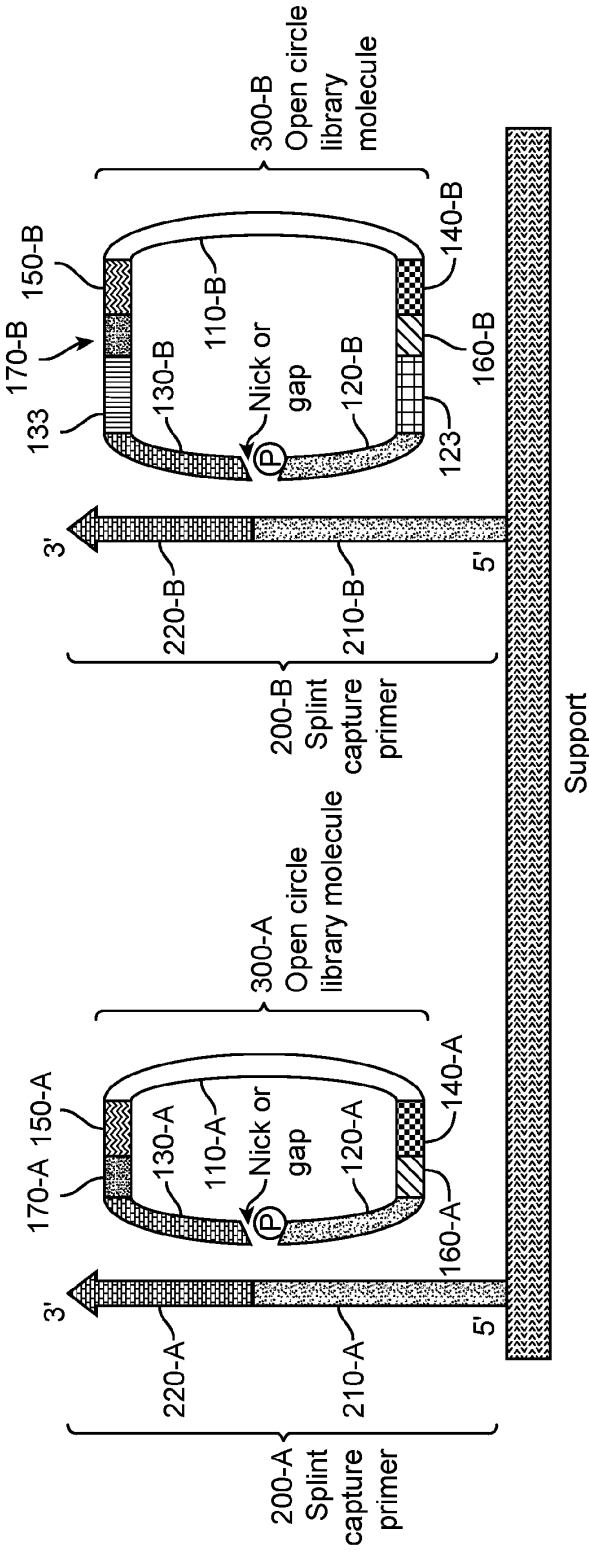


FIG. 27A

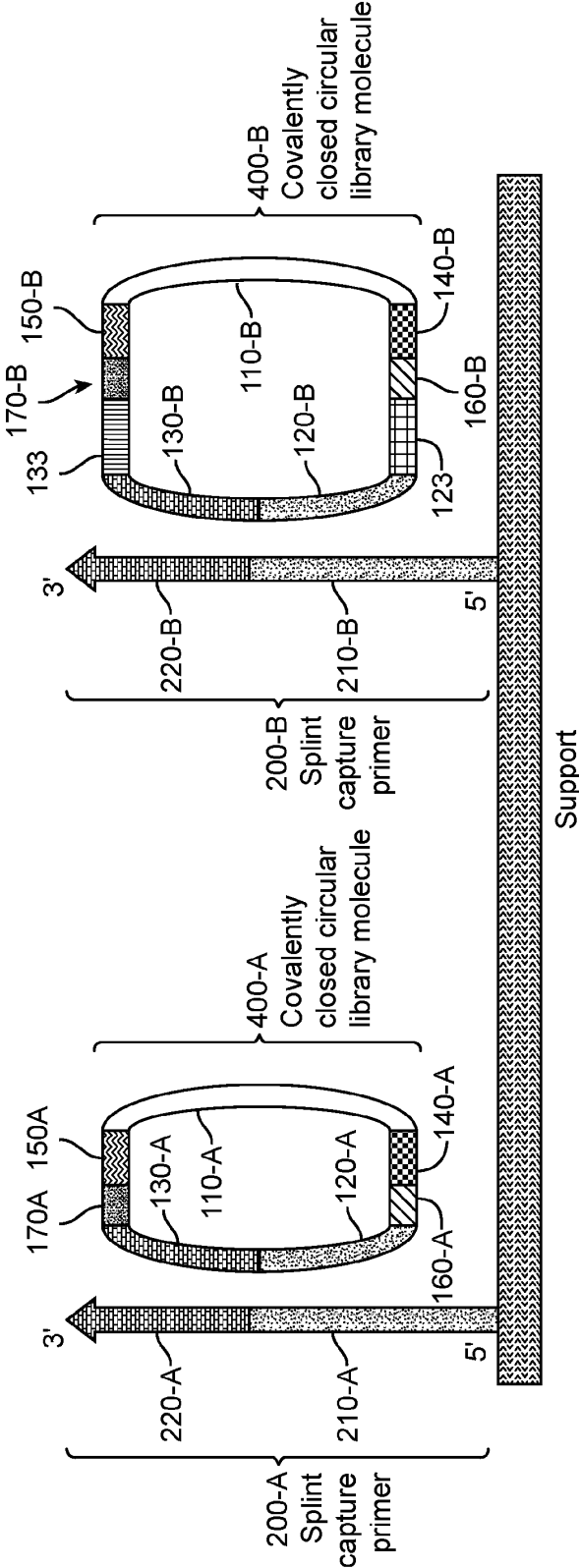


FIG. 27B

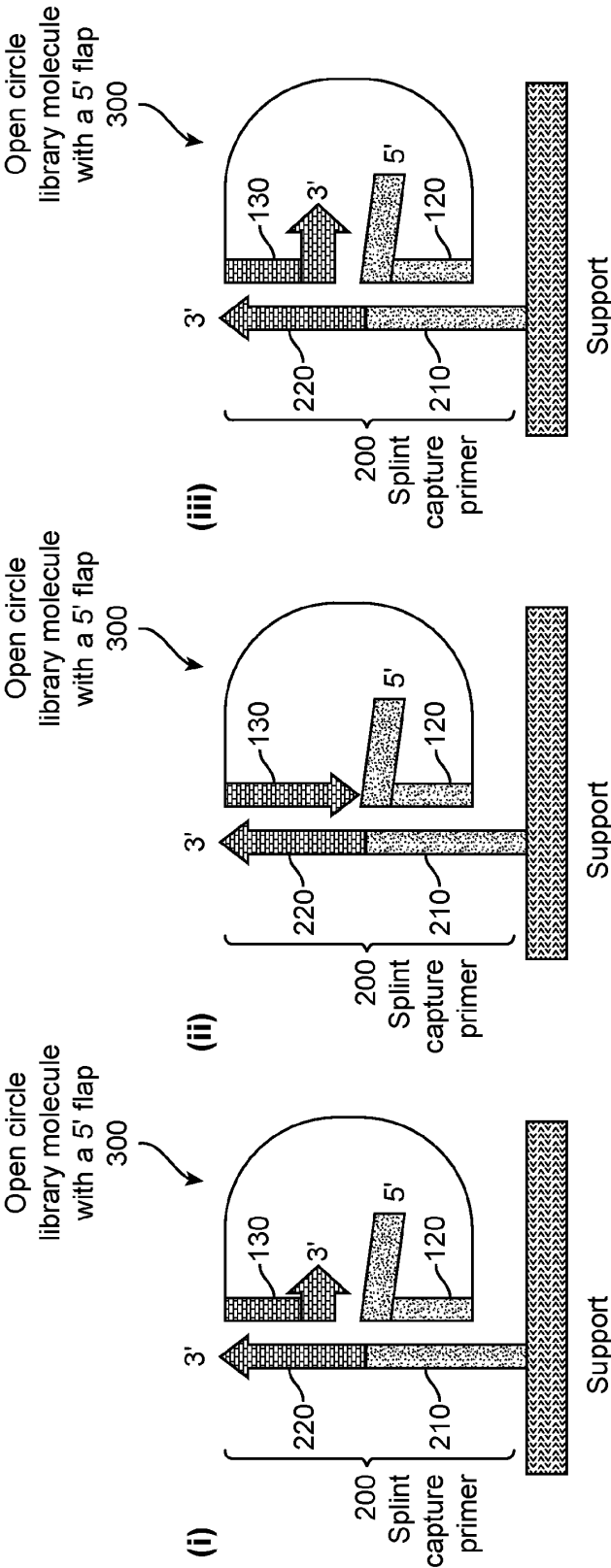


FIG. 28A

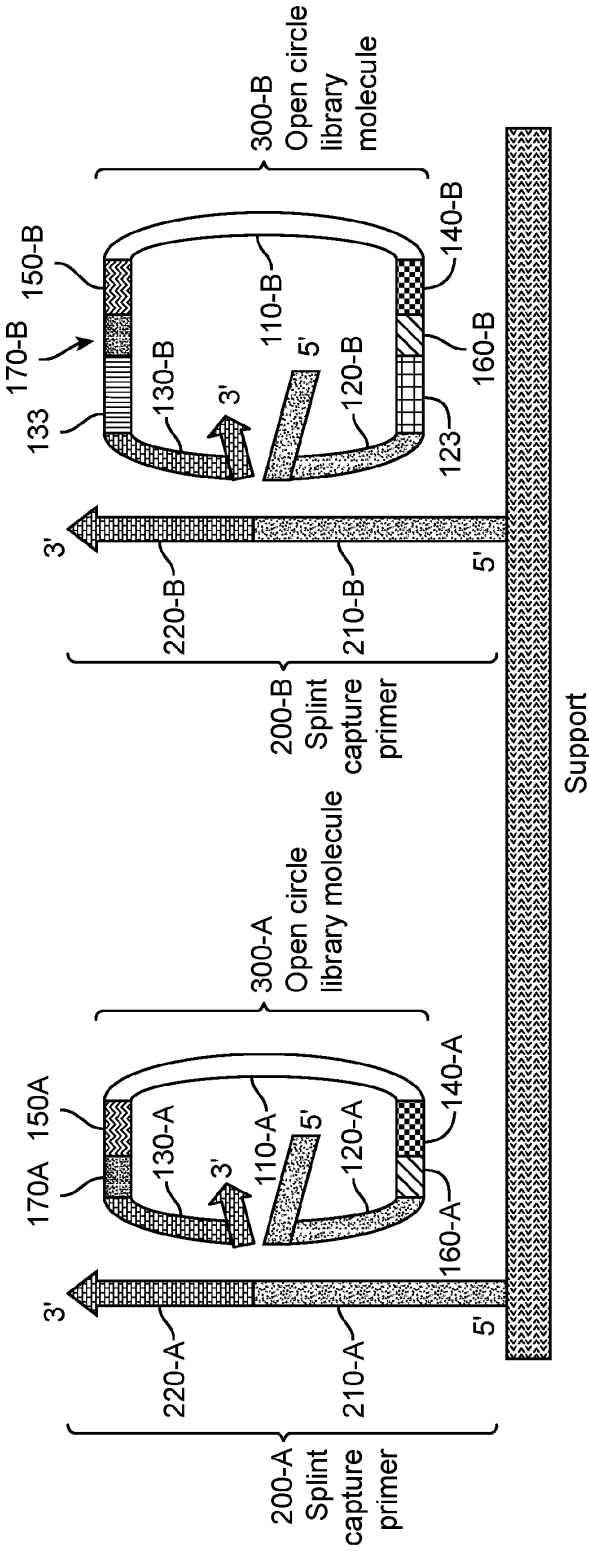


FIG. 28B

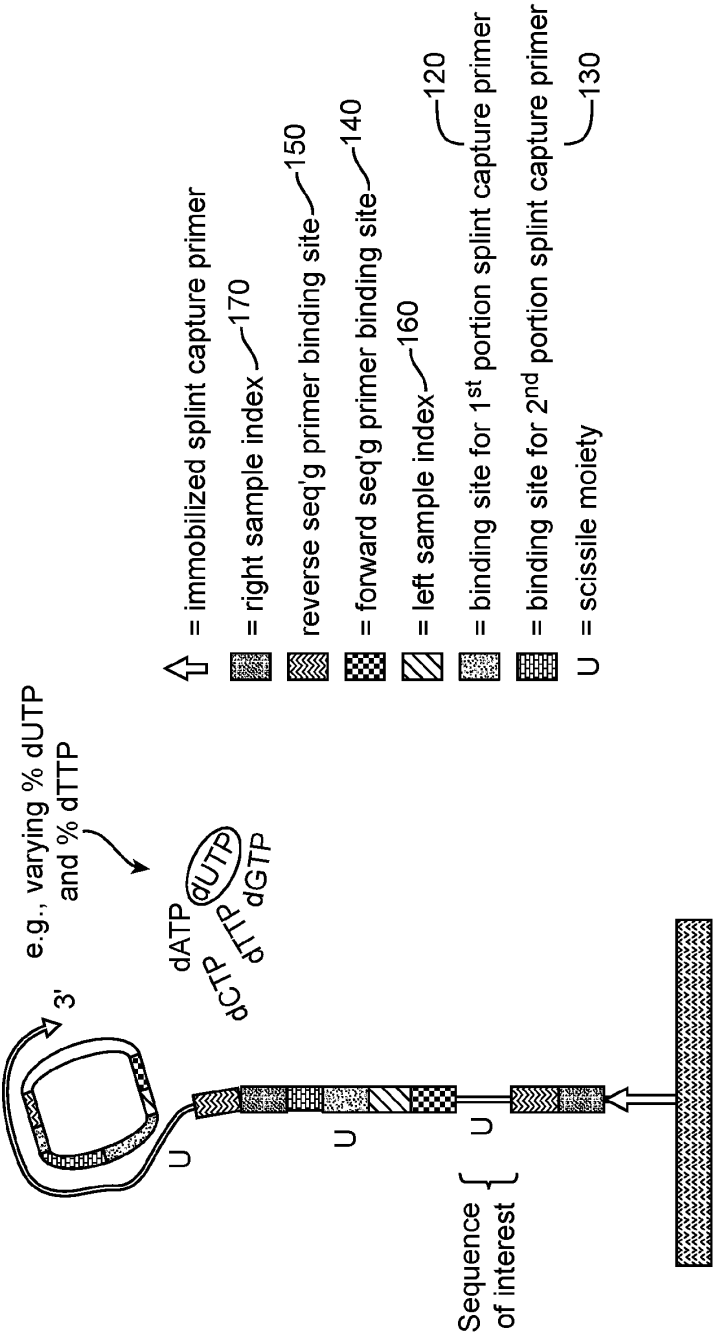


FIG. 29

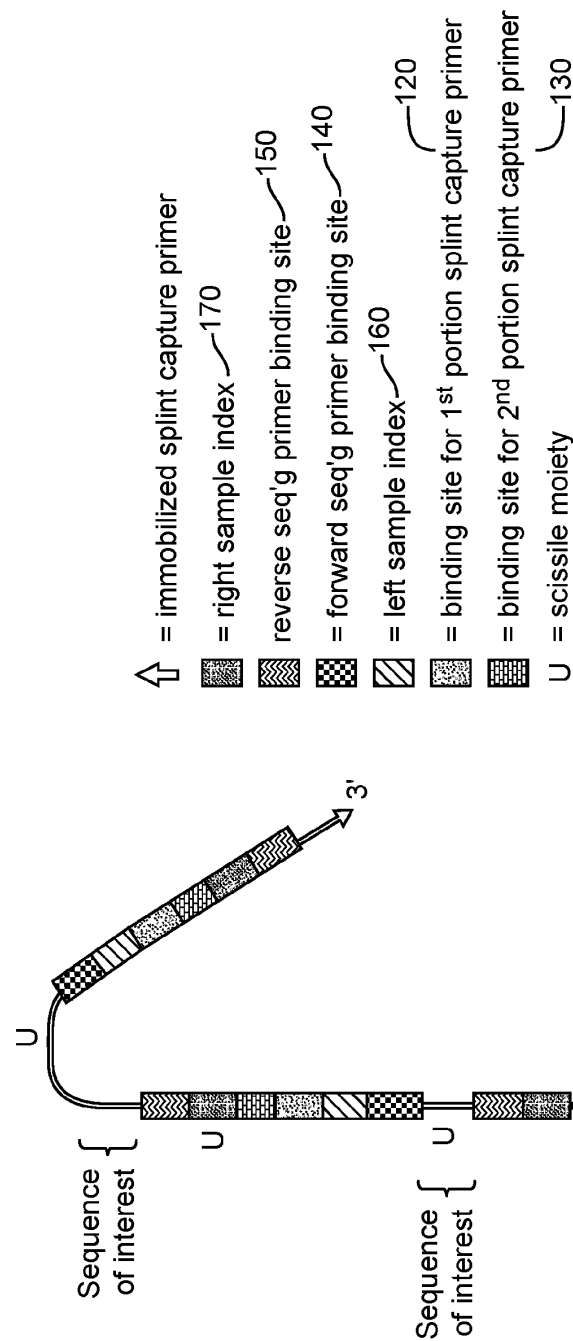


FIG. 30

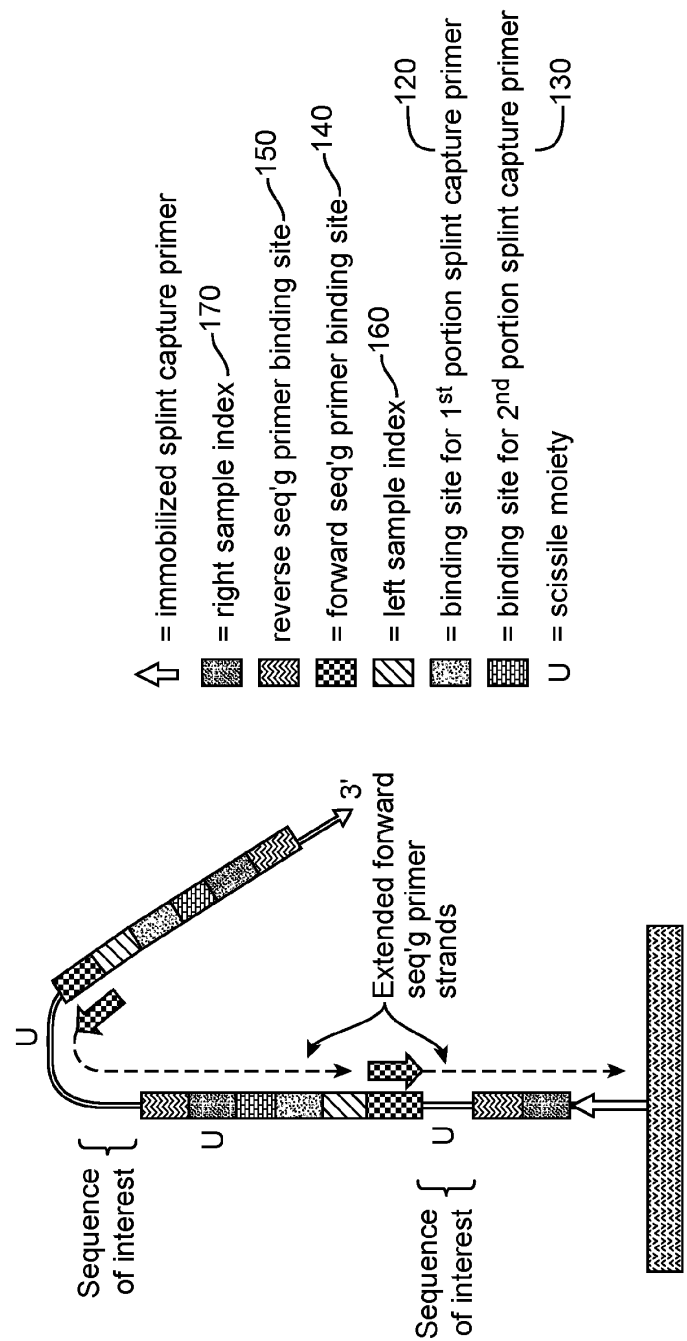


FIG. 31

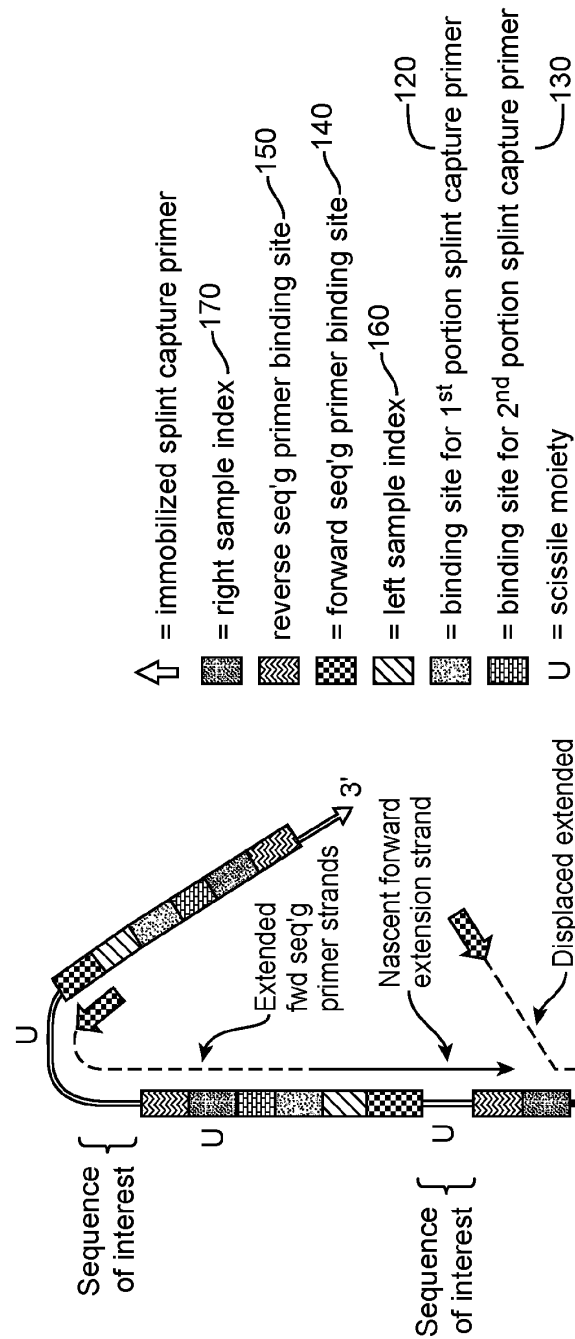


FIG. 32

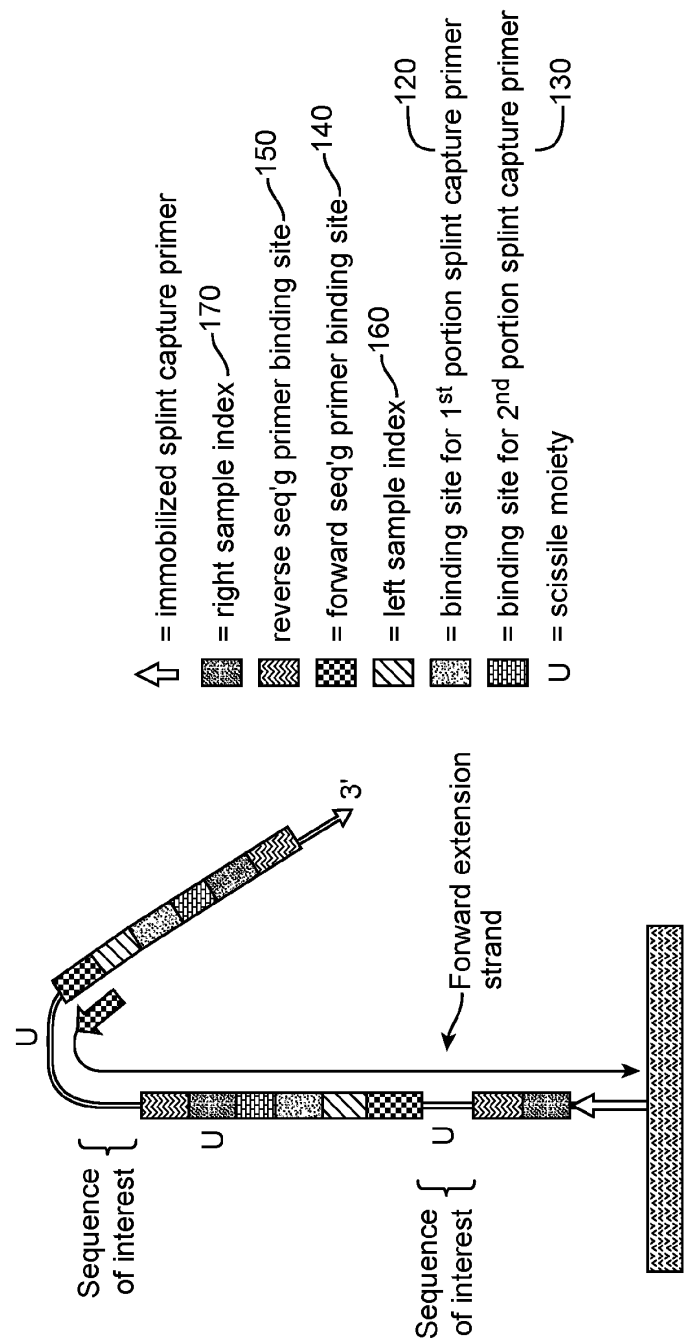


FIG. 33

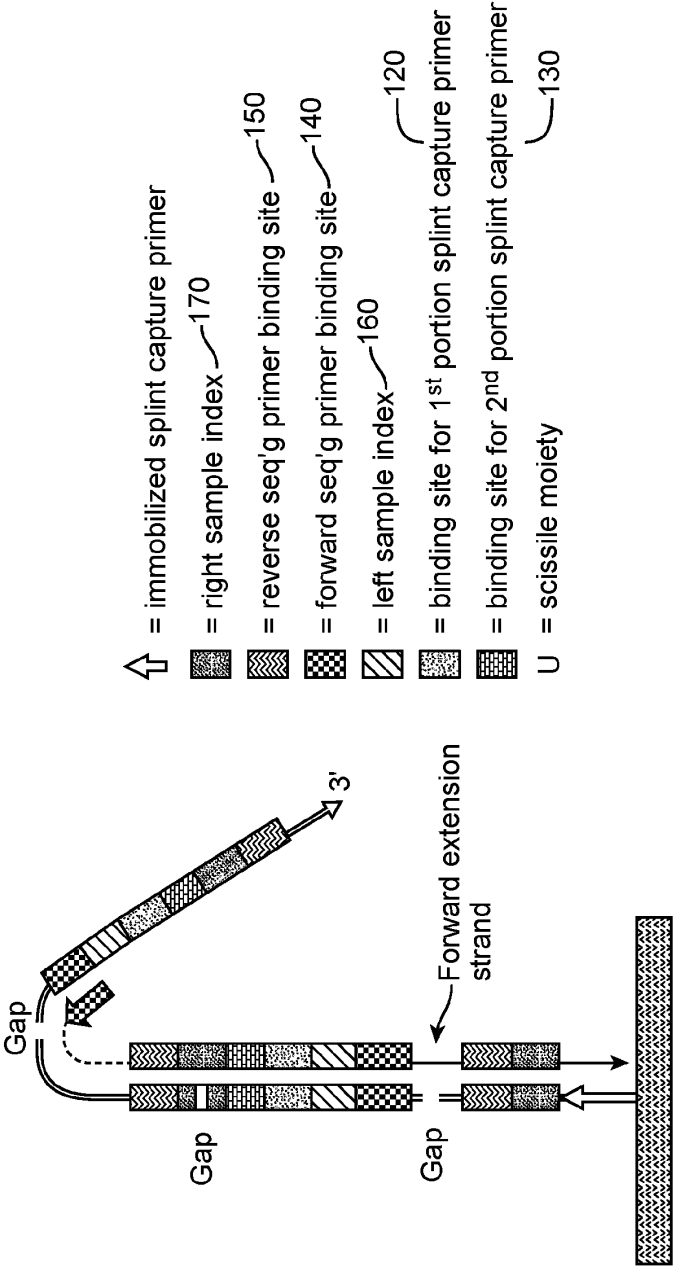


FIG. 34

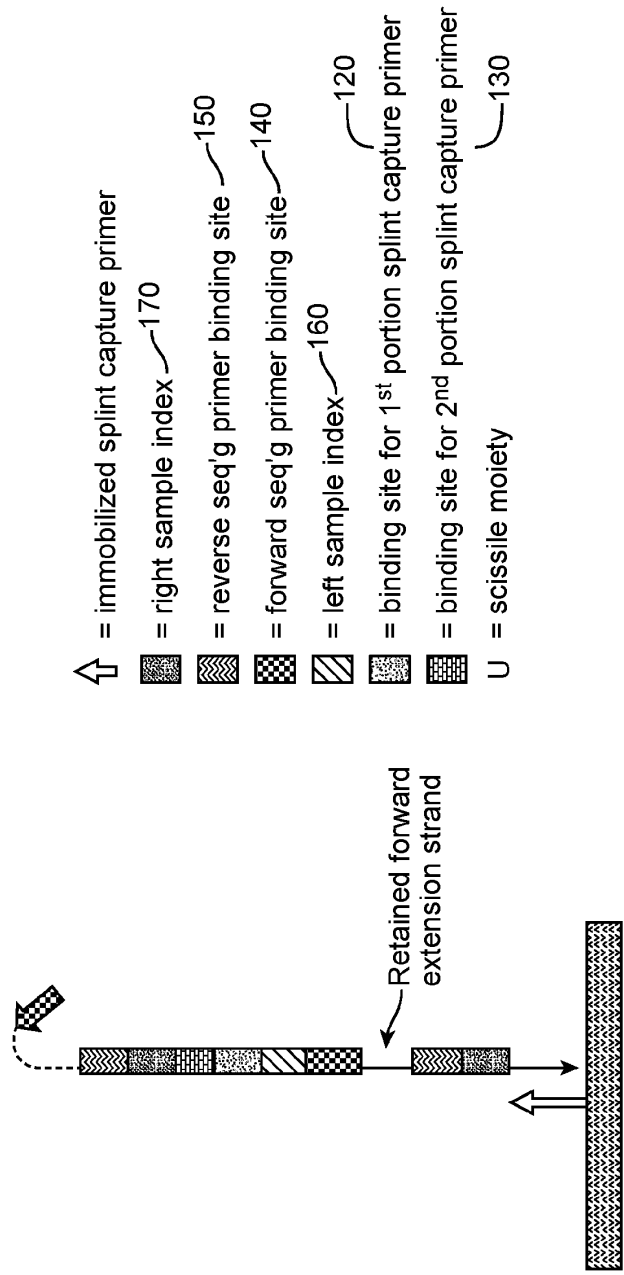


FIG. 35

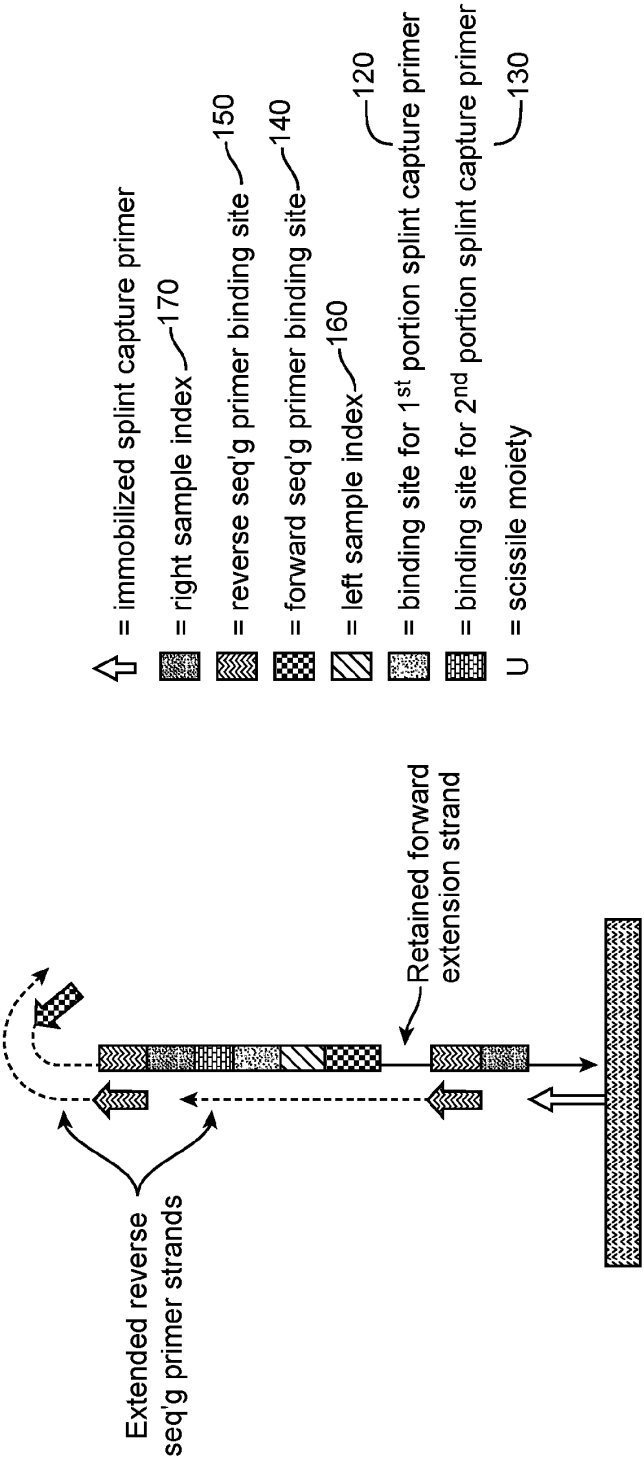


FIG. 36

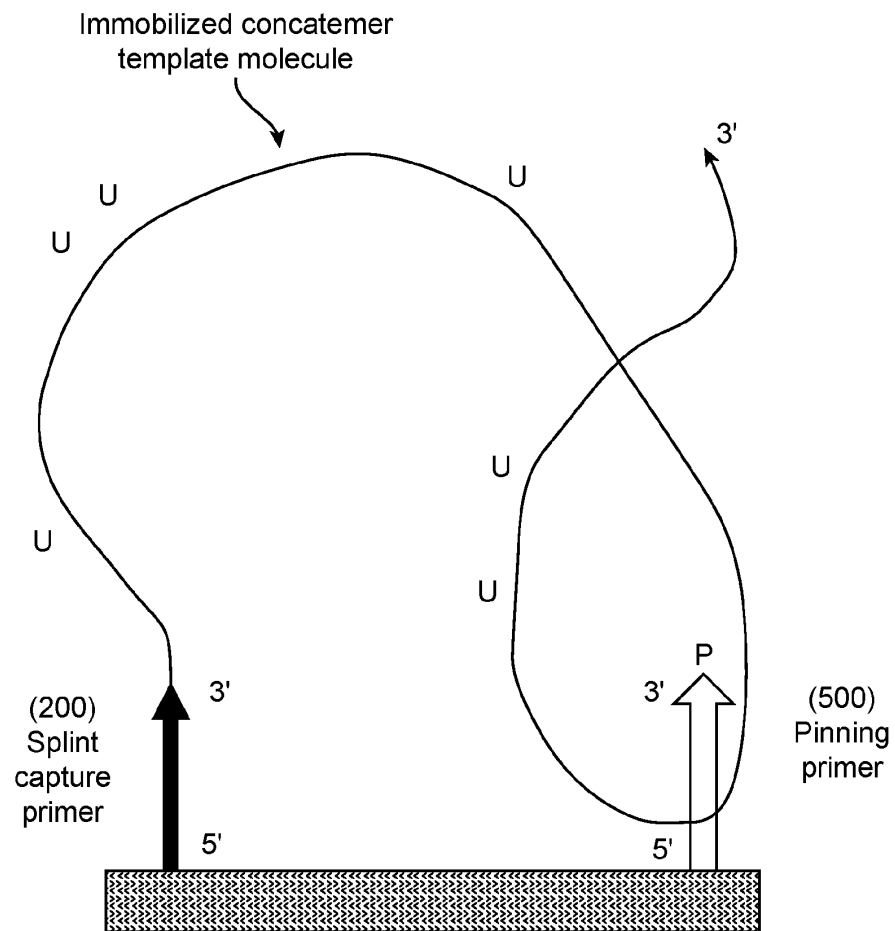


FIG. 37

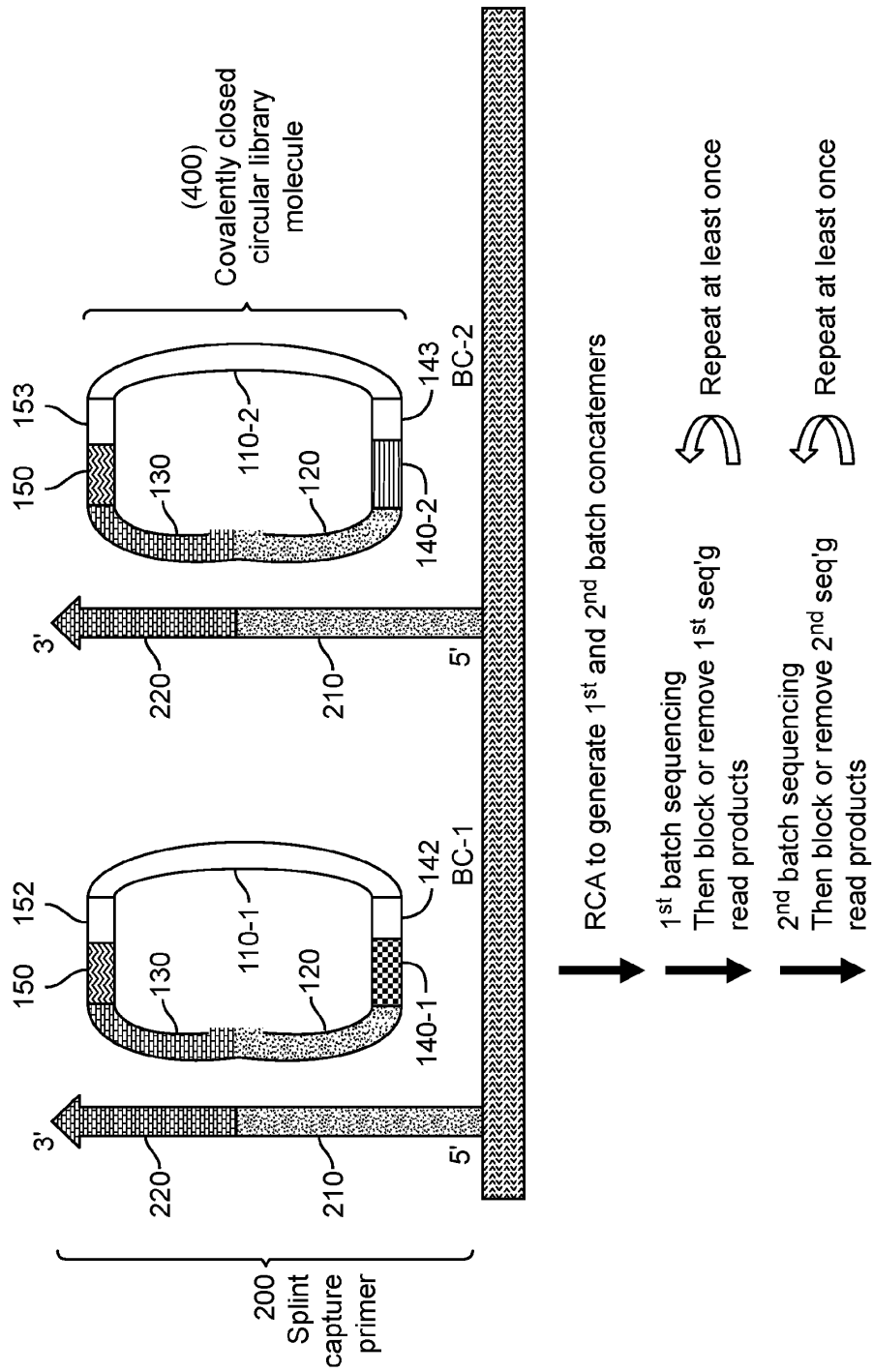


FIG. 38A

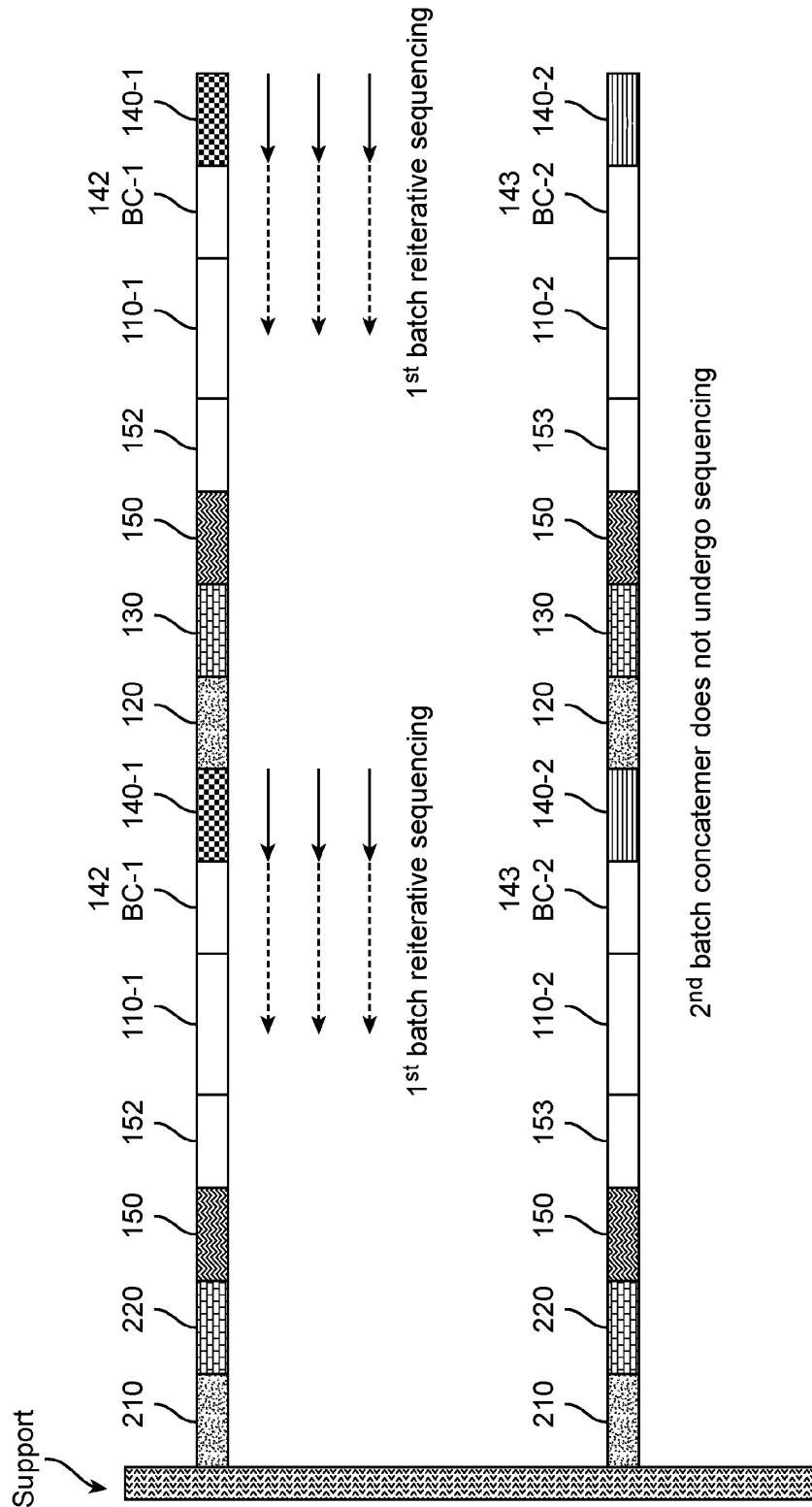


FIG. 38B

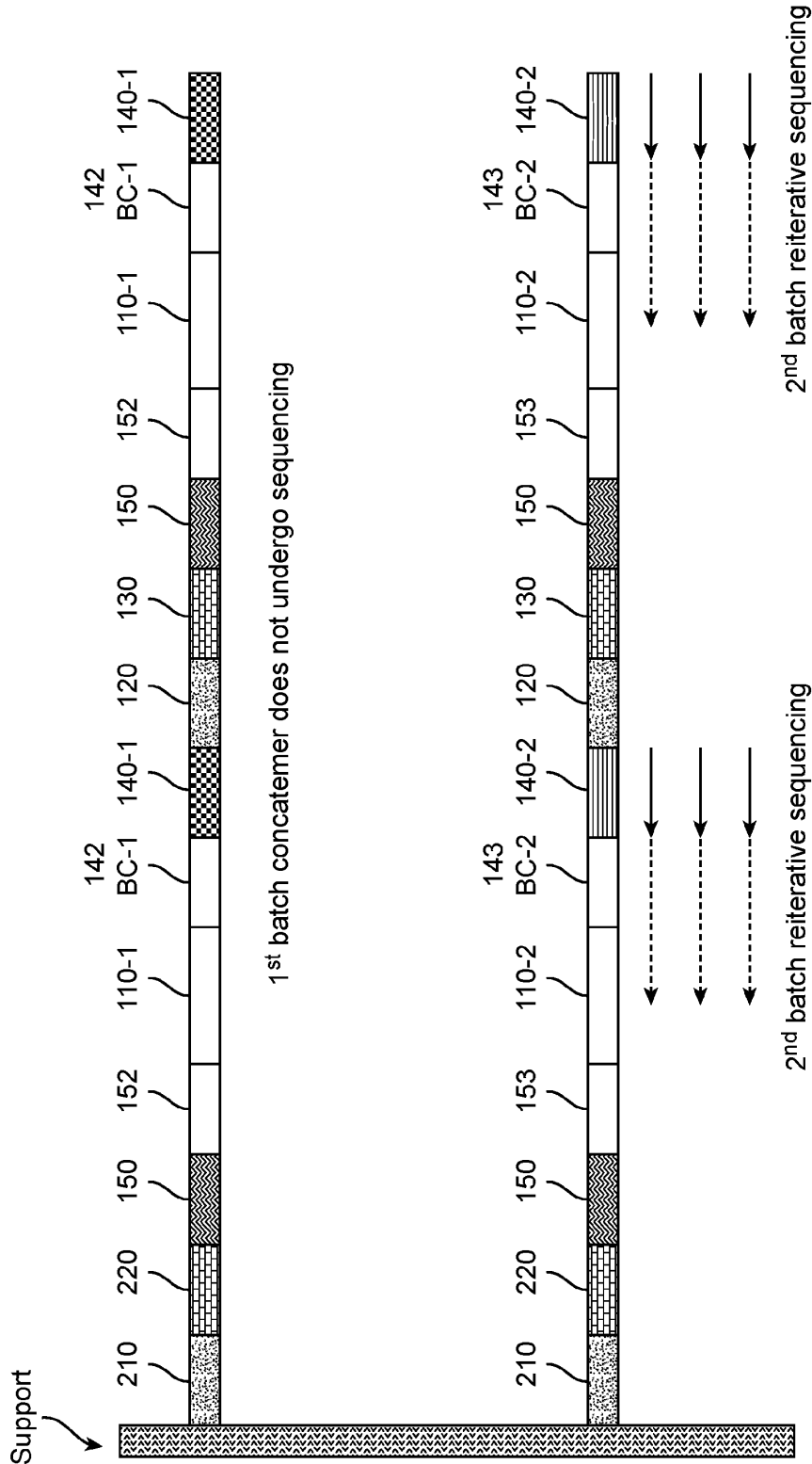


FIG. 38C

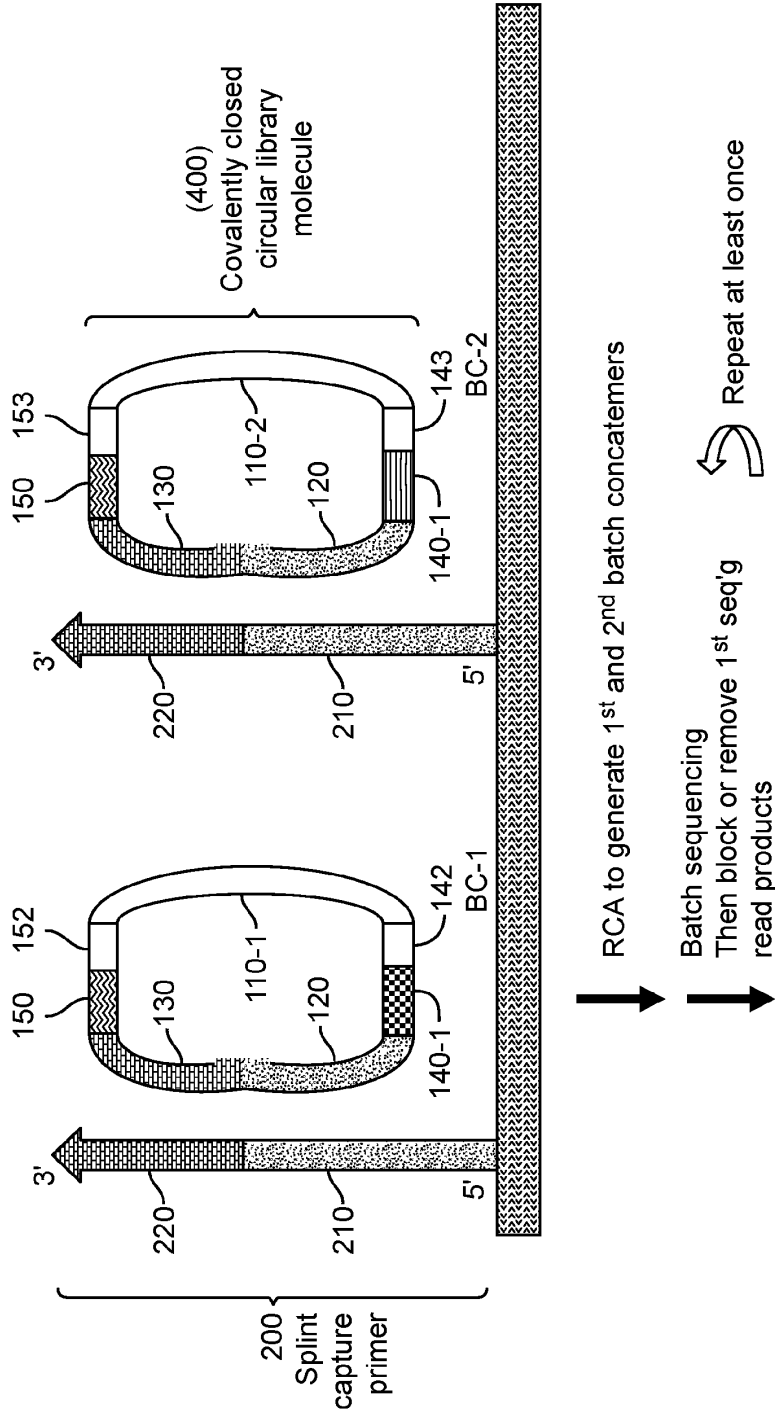


FIG. 39A

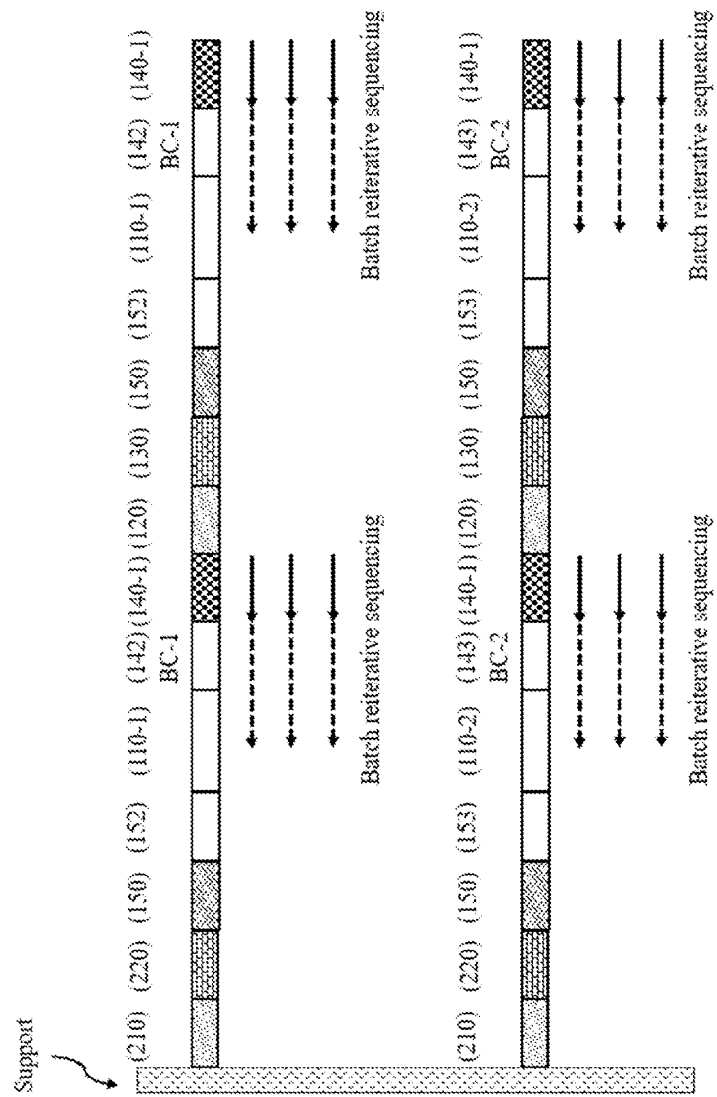


FIG. 39B

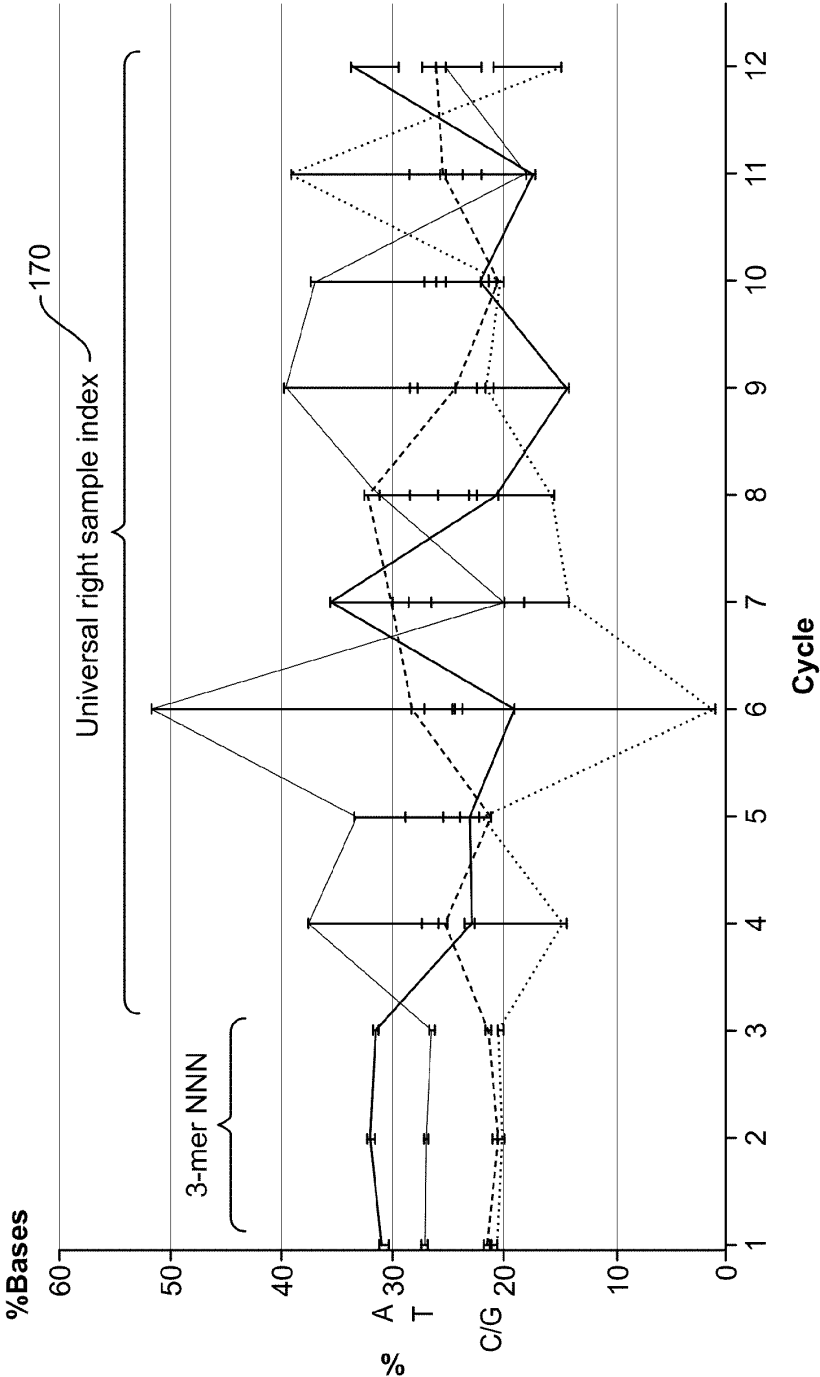


FIG. 40A

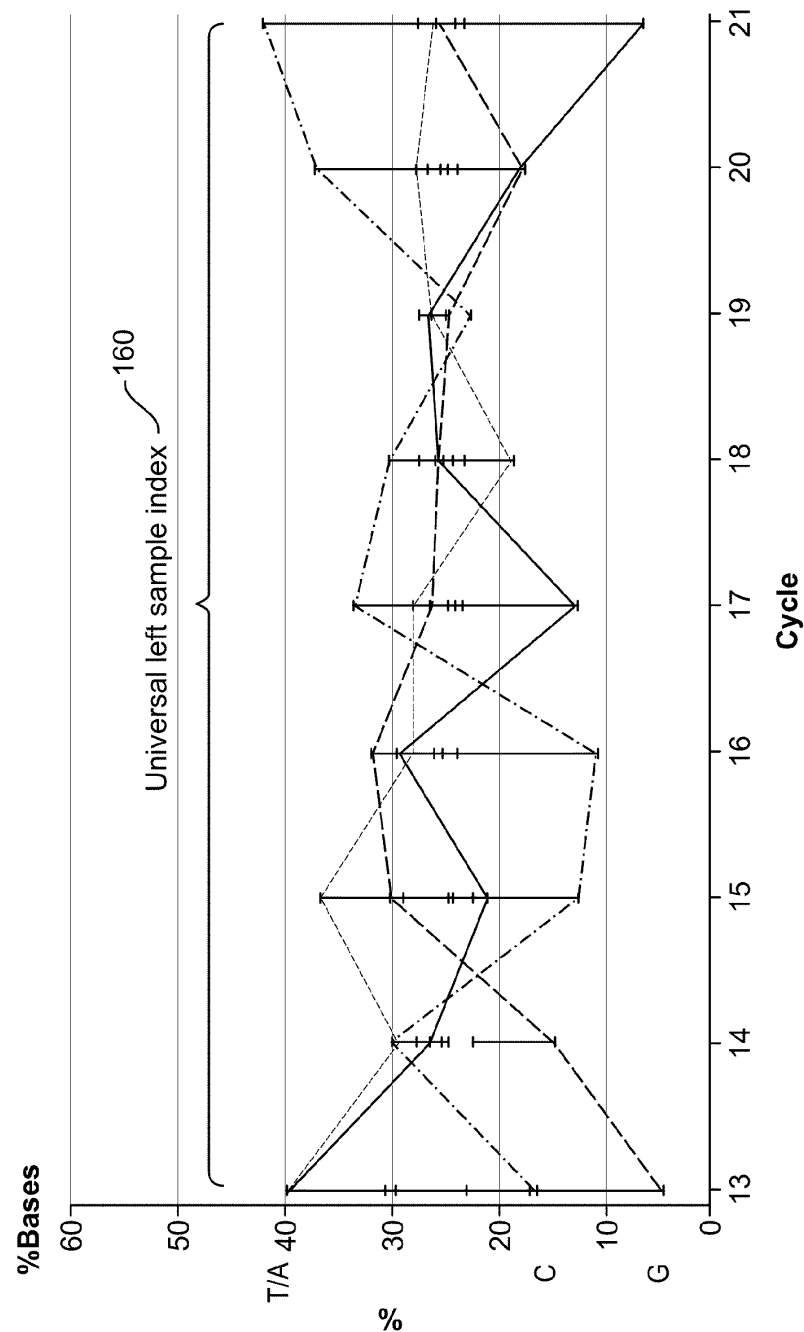


FIG. 40B

Wild type DNA polymerase from *Candidatus altiarchoaeales archaeon*
GenBank accession RLI 89578.1 (SEQ ID NO:128)

MKKTLLDADYITREEKAVVRLFYKTEEGREIQEVADFRPYMYVLPPEHDLKKLQREIKEL
KNITNVEIKRMIEGDREVEVLKVMNQPRDVPNLRGLIKELEGCKEVREAHIPFAERYLI
DSGLIPMQDCENFDLRIAAFDMEVYNPRGEPKAERDPIIISYADNRGLRRVWVWYKTVEN
LNLDYMEVLKDEREIIRRFIDTIREIDIIIVTYNGDNDFPFLKERAEEKHRIPVSLGVD
GSPRLERRGMNLGARVTGRPHIDMYPVCRQIFNLSRYTLEDVYLEITGREKKDIRVGEM
AGIWDNPEKEKFKELIEYAMSDAESTLEIAITLLPLHYEISRTRELIYQSSRAGSGQRV
ESLLIKKAFKESILVFNRPSPDRVNERQKTYIGAYVVEPKRGIHNDNILLDFRSLYPSI
IISHNIDPSTIDCECCPEDSYRSPGTGHYFCKKKRGLIPETLNELVQRRIEVKKGLKNEKN
PERRFLDVKKQALKLLANSMYGYFGFPRAWYCRECAESITAGLGRKYILHTIDIVPKFG
FDVIYGDTDSVYLKPNITDRERVMKNAEHFLDKINSELPEAMELEFEFGFYPRGIFITKK
RYALIDERGKLI VKGLETKRRDWANI AKDTQEKVLDAILKDNPEKAASIVKDVIRNIKT
GKIPLKDLAINTQITRGMAEYKTEGPHIVAACKAMKRGLEFKQGNIVTVVTKKGKSID
KARVIDFEVEGDDYDPDYYINNQVLPVLRILEALGYSEDELKGLGKQMKLGGF

FIG. 41

**Wild type DNA polymerase from Candidatus Hadarchaeum yellowstonense
GenBank accession KUO 42443.1; isolate YNP_45 (SEQ ID NO:129)**

MLLDVDYAEKEEKPSIRLFEVKTGSEVLVAIDPDFEEFYVVS DHPAKASKLIEKVEVEED
GVSI RPKGVEIVKRTFLGNEVEAIKVSYFYQAKDSSKLRHKIRELPGVREIYEFDIPPARR
YLIDRGLTPMAGVEFDGRIEERQGIKTVILDSPRPAQVEEPKLNIMSFIEVYNPTGSV
RPDKDPIIMI SLADNNGLRKVI TWKNFERSQEYVEVVGSE REMIKRFVDLVKERDVIDILL
GYNTDLFDLPYIRSRAKQLKV KLDLGRDGS ELVVRKRRFATA SKIRGRIHVDVFAMVDFL
ATIGSIKLIHYS LADVYRHL LGKEKPDFEFT EMVD AWEKGGDAGRKFLEYSMSDADATLE
VGLELLPLFLGLTRVVGQTLFDVQRMTPGQLVEWLLVAEAHRI GELVPGRPVGE EYEERM
EETFVGAYVMEPVKGLHENLVVDFRSLYPSIIVTHNIDPSTLNCKDCKPGEREQVPGLE
YYFCRRRKGFIPATLQRIIEERMKLKAE LKLVRGTK EYRALDARQWAMKIVANSFYGML
GYPRARWYSKECAESVTSFGRHYIHKTI DMAREFGL EVVYGDTDSLHCKINGKTREEALA
FLKKVNDSLPGIMEIELEGFYPRGIFITKKRYAMIDDEGRMVVKGLEFVRRDWAAIAKKT
QEEVLKAILRDGSP EKA AEIIRKTRDVYEGRVNLEDLIIYTQ LKMPIESYKAIGPHVVA
AKRLRELGHEIEPGMMIAYVEVKGP GSI SERAVPVEDFKGREYDPDYYVGHQVLPAMRI
MEVLGYREIDLKFERQRQVGLDRFMK

FIG. 42

**Wild type DNA polymerase from Hadesarchaea archaeon
GenBank accession MBC 7218772.1; isolate MAG-18 (SEQ ID NO:130)**

MRGLFDVDIAEEEEERNVRLFVKVASETVVAIDPQFEEYFYVADHPAKTSKLIKIEL
DEGGRPIRPKSVEMVRRTLGNEVEAIRVSEHQPRDAAKLRHKIRELPGVKEIYEFDIPP
ARRYLIDRGLTPMAGIEFSGSIEVRDGVKTVMDGPPKPAVETRLNIMSF DIEVYNPT
GSVRPDKDPIIMISLADNRGLRKVITWKNFDKKPEYVEVVGSEMIKKFVELVKERDVD
ILLYNTDLDLPYIRSAKQLRVKLDLGRDGSSELVVRKRRFATASKIRGRVHVDVFAMV
DFLATIGSIRLIHYSLADVYRHYAGREKPDFEFSEMINAWERGGDAGRRLFLEYSMSDADA
TLEVGSLLPLFLGLTRVVGQTLFDVQRMTPGQLVEWLLVAEAHRI GELVPPRPVGEEFE
ERAEGTFTGAYVMEPVKGLHEDLVVDFRSLPSIIVTHNIDPSTLNCRDCKPGEREQVP
GLSYFCKRRKGFIPAVLERVIEERTKLKAEKKIGRETREYRALDARQWAMKIVANSFY
GMILGYPRARWYSKQCAESVTSFGRHYIHRTIEMAREFGLFVVYGDTS LHCKLNGKTRREE
AMVFLRKVNESLPGIMELELEGFYPRGIFITKKRYAMVDDEGRMVVKGLFVVRDWA AIA
KKTQEEVLRAILRDGSPKAAEIIRKTTDVDYEGRVNLEDLIITYQLKMPIESYKAIGPH
VVAAKRLRELGHEIEPGMMIAYIEVKGPGSISDRAPVEDFEGKEYDPDYYVGHQILPAV
MRIMEVLGYSEEDLKFFEREKQIGLDRFMK

FIG. 43

Wild type DNA polymerase from Euryarchaeota archaeon
GenBank accession NOZ 58130; isolate M_MaxBin.100 (SEQ ID NO:131)

MPRI LKGF LIDADYETVEGRALIRLFLRGEESFVYDDSFSPYFYALPGDEPERVKERI
LASGAAEAIQKVEIEEKRLFGTTPRVALRITVSHPDQDVPRIRRRVVEGVDLILEHDILF
VRRYLIDRGIKPLTWLRLEVEERDGRALLRGVEQLEEEPPELRVAADVIEVYNPKGAPRS
SKDEIIMISVATSDGVEKVLTWREVQGLEQVEVLQDEKEMLLRFAELIKEGDYDVI VGYN
TDSFD'FPYIRDRLKKLGISLPLGRLDAAELEVSRRGALPEARIRGRAHVDLYPIVRRHVKL
NSVLESVVEELGKKEKLDGERLFTYWDEGGEKRALIARYALEDARVTLALAEKFLPL
YCELSITVGSNDVARMTSQQLVEWLLMRYPATPRGELIPNHPAGEEYAAARATYAGGY
VREP KRG LVEHIAVDFRSLPSIIVSHNIDPSTLIVGNCEENRAPELEYCFSLEREGFI
PAILKELIRRAEIKRELKRSEGD RRRTLSFAEKALKILANSFYGYMGYPRARWYRRECA
ESVAAFARMYIKQVMRIAEEEFKLEVYGD TDSL FVVIPEKRELAQKFLQKVNESMPGI
IEIEFEGFYRRGLFVTKKRYALLSEDGKMWVGLEFVRRDWAPIARETQKEVLRILLEEA
DPEKAARLVRDVIERIRQRRVSLEDITITYQLTKRIKSYKSLEPHVVAQAQKLKERGREVA
PGMIIGYIITKGTGIGISQRATPVFEFARLEDYDPEYYIDNQILPAIQRIFEAIGYTRDYLK
EGITQTSLSRWF

FIG. 44

Wild type DNA polymerase from Euryarchaeota archaeon
GenBank accession RMF 90817.1; isolate J060 (SEQ ID NO:132)

MARDLLDIDYVTVDEKAQVRLFLKDKILFDPGFQPYFYVLAHDGAVEERLRDFGAVEAV
QRRMLGREMRFFKLLILSHPSEVPKIREEVRSIEGVEGIFEHDLFARRYLIDKGLTPLNY
AEYRAEQGFLKGISSAGEGPESLRVMAFDIETYNPKGAPRAEKDPVIMLSLSTNTGLRRL
LTKSGEGLDFVELVEDEKALLHRFKELVNEEGVEVLVGYNSDQFDLPYLVARAKALGVE
LPLGQDGSQQIRKGRGLVESVVKGRPHVDLPIVRRNVRLSSYVLENVVKVGLGREKEK
IPHDAMCGYDRGGRELQRFMAYSMEDADVTELAERFLPLYIELSRVVGGLPHDVARMT
AGQLVEWLLIREAFARGEVVPNKGSGREYLARSEDTYAGGYVMEPVKGIVENIVVDFRS
LYPSIIVTHNIDPATLRPGRGENSPPELDYHFTTEEGFIPSVLKRVLERRLSAKRRMKE
ARDPGEKRLDISQALKIIANSFYGYMGYPRARWYKKCAESVTSFARMYTKKVMAIAE
EEYGFVGVYGDTSILFVVQPEEKERAMSFMEDVNRRLPGTVELEYDGFYPRGFIITKKR
YALIDEKGNIVVKGLETVRRDWTRLSDTQQKVLSVIIREGDPKKAADIVKDTINRLKER
RVDLEDITITYTQLTGIGRYKNVGPVKAQKAI DRGRENPGMAIGYIIKKGRGLISDR
AEPVEDATIEDYDVDYYIENQVLPVVARIMEVLGYSKEHLKEEMVQGSIQRWF

FIG. 45

Wild type DNA polymerase from Euryarchaeota archaeon
GenBank accession NOZ 77387.1; isolate M_MaxBin.027 (SEQ ID NO:133)

MDGFLLDVDYKTVDEKPVVRLFLRDVIALDPSFRPYVYVACDDPRAVAGEIKDLELDGRR
PVTGVEEMERGLGRPRREFLKVYLGHFPQQVPRVRDLRLRLPGVSAVLEDDILFSRRYLID
KGLVPTAWVELQGRVEGSEFWEEVRAEGPLPRLKVMSFDIETYNPKGAPRGDQDPIIM
VSMATSGGLRKVLSWKAPTAGLEFVETLEDEAAVLRFEELVRQEDPDILVGYNTDNFDF
PYNQRLKALGIELALGRDGSPhKTSTRMGSETRMAGRPHMDLYPIVRRSLRLPSYVLE
DVVAEVLGEEKEKVPGERMGEIWDKGGEELDRFFRYSLEDAEVTLRIGEKYLPYIELSR
LVGQSIHDVARMTAGQLVEWYLMREAFARGEVIPHERPGGREFARRAGDTYEGGYVREPRK
GLLEKVFDFRSLYPSVIVTHNIDPSTIRPGGENQPPGIDYHFTTEKEGFI PALLRRLVA
RRAELKEEMKKARDPGERKMLDVQQQALKILANSFYGYMGYPRARWYRKECAESVTAFAR
DYIKKVMEEVAEKEFGLEVYGDTSLSFIIVPGGKKERAFAFLEEVNRRILPGTIELEYEGF
YRRGIFVTKKRYALIDEKDRIIVKGIEFVRRDWAPIARDTQEKVLKALIKDASPEEAVRI
VRKAMDDIRARRVSLEDLTIYTQLTKK

FIG. 46

Wild type DNA polymerase from Thermococci archaeon
GenBank accession RLF 89458.1; isolate B13_G1 (SEQ ID NO:134)

MILDTYITENGKPVIRIFKKEKGEFKIEYDRNFEPYIYALIEDDESIEDIKKITGERHG
KKVRIIRVEKVKKKFLGEPiEVWKLVEFHPQDVPDAIRDAIRSHPAVREIFEYDIPFAKRY
LIDKGLVPMEGGEELKLLAFDIETFYHEGDEFAEGEILMISYADESGAKVITWKKIDL
VEVSTEREAIKRFLQVLREKDPDVLTTYNGDNFDFAYIKRCEKGLGLKFTIGRDGSEPK
IQRMGDRFAVEVKGRIHLDLYPVVRHTIRLPTYTLEAVYEAVFGKKKEKVYAEFIAEAWK
SEGLKRVAQYSMEDARATYELGREFFPMEVELAKLIGQSVWDVSRSTGNLVEWYLLRV
AYERNELAPNKPGEYQRRMRSSYIGGYVKEPEKGLWESIAYLDFRSLYPSIIVTHNVS
PDTLEKECKNYDVAPIVGYRFCKDFKGFIPSILEDLIETRQKVRRMKATIDPIEKKMLD
YRQALKILANSYYGYQGYPKARWYSKECAESVTAWGRHYIETTIKEAEKFGFKVLYADT
DGFATIPNEKPETIKSKAKKFLKHINEKLPGMLELEYEGFYLRGFFVTKKKYALIDEDG
HITTRGLEVVRRDWSEIAKETQAKVLEVILREGSIEKAAGIVKKVVEDLANYRVVPEKLI
IHEQITRELKDYKATGPHVAIAKRLQARGIKVKPGTIIISYVVLKGSKKISDRVILFDEYD
SSRHKYDPDYIHNQVLPVAVLRILEAFGYKEKDLEYQRMKQTLGAWLKMGGK

FIG. 47

Wild type DNA polymerase from Thermococci archaeon
GenBank accession RLF 78286.1; isolate B89_G9 (SEQ ID NO:135)

MILDTDYITENGKPVIRIFKKEKGEFKIEYDRNFEPYIYALLEDESIEDIKKITGERHG
KKVRIIRVEKVKKKFLGEPFIEVWKLVEHPQDVPAIRDAIRSHPAVREIFEYDIPFAKRY
LIDKGLVPMEGGEELKLLAFDIETFYHEGDEFAEGEILMISYADESGAKVITWKKIDLPI
VEVSTEREAIKRFLQVLREKDPVLLTYNGDNDFAYIKKRCEKLGKFTIGRGSEPK
IQRMGDRFAVEVKGRIHLDLYPVVRHTIRLPTYTLEAVYEAVFGKKKEKVYAEETAEAWK
SEGLKRVAQYSMEDARATYELGREFFPMEVELAKLIGQSVWDVSRSSGTNLVEWYLLRV
AYERNELAPNKPGEERYQRRMRSSYIGGYVKEPEKGLWESLAYLDFRSLYPSIIVTHNVS
PDTLEKECKNYDVAPIVGYRFCKDFKGFIPSILEDLIETRQKVKKMKATIDPIEKKMLD
YRQALKILANSYGYQGYPKARWYSKECAESVTAWGRHYIETTIKEAEKFGFKVL YADT
DGFATIPNEKPETIKSKAKKFLKHINEKLPGMLELEYEGFYLRGFFVTKKKYALIDEDG
HITTRGLEVVRDWEIAKETQAKVLEVILLREGSIEKAAGIVKKVVEDIAN YRVPVEKLI
IHEQITRELKDYKATGPHVAIAKRLQARGIKVKPGTII SYVVLKGSKKISDRVILFDEYD
SSRHKYDPDYYIHNQVLPVAVLRILEAFGYKEKDLEYQRMKQGTGLGAWLKMGGK

FIG. 48

Wild type DNA polymerase from *Thermococcus* sp. 2319x1
GenBank accession WP 175059460.1 (SEQ ID NO:136)

MILDYITKDGKPIIRIFKKENGFKIELDPHFQPYIYALLKDDSAIEEIKAIKGERHG
KTVRVLDVAVKVRKKFLGREVEVWKLIFEHPQDVPAMRDKIKEHPAVIDIYEYDIPFAKRY
LIDKGLIPMEGDEELKLLAFDIETFYHEGDEFGKEIIMISYADEEEARVITWKNIDLPI
VDVVSNEREMIKRFVQVVEKDPDVIITYNGDNFDLPYLKRAEKLGIKRLVGRDKENPE
PKIQRMGDSFAVEIKGRIHFDLFPVVRTINLPTYTLEAVYEAVLGKTKSKLGAEIIAAI
WETEESMKKLAQYSMEDARATYELGKEFFPMEAEALAKLIGQSVWDVSRSTGNLVEWYLL
RVAYARNELAPNKPDEEEYKRRRLRTTYLGGYVKEPEKGLWENIYLDFRSLYPSIIVTHN
VSPDTLEKEGCENYDIAPIVGYKFKCKDFPGFIPSIIGDLIAMRQEIKKMKATIDPIEKK
MLDYRQRAVKLLANSYYGYMGPYKARWYSKECAESVTAWGRHYIEMTIKEIEEKFGFKVL
YADTDGFYATIPGEKPEIIEKKAREFLNYINSKLPGLLELEYEGFYLRGFFVTKRYAVI
DEEGRIITTRGLEVVRRDWSIEAKETQAKVLEAILKDGVEKAVEIVRDVVEKIAKYRVPL
EKLVIHEQITRDLKDYKAIGPHVSIKRLATRGIKVKPGTII SYLVKGGGRISDRVILL
TEYDPEKHKYDPDYIENQVLPVLRILEAFGYRKEDLRYQSSKQTGLDAWLKR

FIG. 49

Phi29 DNA polymerase UniProtKB/Swiss-Prot: P03680.1 (SEQ ID NO:137)

MKHMPRKMYSCDFETTTKVEDCRVWAYGYMNIEDHSEYKIGNSLDEFMAWVLKVQADLYF
HNLKFDGAFIINWLERNGFKWSADGLPNTYNTIISRMGQWYMIDICLGYGKRRKIHTVIY
DSLKKLPFPVKKIAKDFKLTVLKGDIDYHKERPVGKITYPEEYAIKNDIQIIEALLIQ
FKQGLDRMTAGSDSLKGFKDIIITTKFKKVFPTLSLGLDKEVRYAYRGFTWLNDRFKEK
EIGEGMVFDVNSLYPAQMYSRLLPYGEPVFEFGKYVWDEYPLHIQHIRCEFEFELKEGYIP
TIQIKRSRFYKGNEYLKSSGGEIADLWLSNVDLELMKEHYDLYNVEYISGLKFKATTGLF
KDFIDKWTYIKTTSEGAIKQLAKMLNSLYGKFASNPDTVTKVPYLGKENGALGFRLGEEE
TKDPVYTPMGVFI TAWARYTTITAAQACYDRIIYCDTDSIHLTGTEIPDVIKDIVDPKKL
GYWAHES TFKRAKYL RQKTYIQDIYMKEVDGKLVEGSPDDYTDIKFSVKCAGMTDKIKKE
VT FENFKVGF SRKMKPKPVQVPGGVVLVDDTFTIK

FIG. 50

Wild type DNA polymerase from *Geobacillus stearothermophilus* (Bst polymerase)
GenBank accession AAB52611.1 (SEQ ID NO:138)

MKKKLVLDGNSVAYRAFFALPPLLHNDKGIHTNAVYGF TMLNKLAEEQPTHLLVAFDA
GKTTFRHETFQYKGGRRQQTPELSEQPPLRELLKAYRIPAYELDHYEADDIIGTLAAR
AEQEGFEVKIISGDRDLTQLASRHVTVDITKKGITDIEPYTPETVREKYGLTPEQIVDLK
GLMGDKSDNIPGVPGIGECTAVKLLKQFGTVENVLASIDEVKGEKLENLRQHRDLALLS
KQLASICRDAPVELSLDDIVYEGQDREKVIALFKELGFSFLEKMAAPAAEGEKPLEEME
FAIVDVI TEEMLADKAALVVEVMEENYHDAPIVGIALVNEHGRFFMRPETALADSQFLAW
LADETKKSMFDAKRAVVALKWKGIELRGVAFDLLLLAAYLLNPAQDAGDIAAVAKMKQYE
AVRSEAVYGGVKRSLPDEQTLAEHLVRKAAAIWALEQPFMDDLRNNEDQDQLLTKLEQP
LAAILAEMEF TGVNVDTKRLEQMGSELAEQLR AIEQRIYELAGQEFNINSPKQLGVILFE
KLQLPVLKKTGTGYSTADVLEKLAHPHEIVENILHYRQLGKLQSTYIEGLLKVVRPDTG
KVHTMFNQALTQTGRLSSAEPNLQNIPIRLEEGRKIRQAFVPSEPDWLI FAADYSQIELR
VLAHIADDNLI EAFQRDLDIHTKTAMDIFHVSEEEVTANMRRQAKAVNFGIVYGISDYG
LAQNLNITRKEAAEFIERYFASFPGVKQYMENIVQEAQKQGVTTLLHRRRYLPDITSRN
FNVRSF AERTAMNTPIQSSAADIKKAMIDLAARLKEEQQLQARLLLQVHDELILEAPKEE
IERLCELVPEVMEQAVTLRVPLKVDYHYGPTWYDAK

FIG. 51

9°N polymerase (SEQ ID NO:139)

MILDYITENGKPVIRVFKKENGFEKIEYDRTFEPFYALLKDDSAIEDVKKVTAKRHG
TVVKVRAEKVQKKFLGRPIEVWKLYFNHPQDVPAIRDRIRAHPAVVDIYEYDIPFAKRY
LIDKGLIP^AEGDEELTMLAFDIETLYHEGEFETGPILMISYADGSEARVITWKKIDLPI
VDVSTEKEMIKRFLRVREKDPDLITYNGDNDFAYLKKRCEELGIKFTLGRDGSEPK
IQMGDRFAVEVKGRIHFDLYPVIRRTINLPTTYTLEAVYEAVFGKPKEKVYAEELAQAW
SGGLERVARYSMEDAKVTYELGREFFPMEAQLSRLIGQSLWDVSRSTGNLVEWFLLRK
AYKRNELAPNKPDERELARRGGYAGGYVKEPERGLWDNIVYLDFRSLYPSIIITHNVSP
DTLNREGCKEYDVAPVGHKFKDFPGFIPSLGDLLEERQKIKRKMKATVDPLEKKLLD
YRQRAIKILANSFYGYGYAKARWYCKECAESVTAWGREYIEMVIRELEEKFGFKVLIAD
TDGLHATIPGADAEVKKKAKEFLKYINPKLPGLLELEEGFYVRGFFVTKKKYAVIDEE
GKITTRGLEIVRRDWSEIAKETQARVLEAILKHGDVEEAVRIVKEVTEKLSKYEVPPEKL
VIHEQITRDLRDYKATGPHVAVAKRLAARGVKIRPGTVISYIVLKGSGRIGDRAIPADEF
DPTKHYDAEYYIENQVLPAYERILKAFGYRKEDLRYQTKQVGLGAWLKVKGKK

FIG. 52

9^N polymerase
UniProtKB - Q56366 (DPOL_THES9) (SEQ ID NO:140)

MILDTDYITENGKPVIRVFKKENGFEKIEYDRTFEPYFYALLKDDSAIEDVKKVTAKRHG
TVVKVRAEKVQKKFLGRPIEVWKLYFNHPQDVPAIRDRI RAHPAVVDIYEYDIPFAKRY
LIDKGLIPMEGDEELTMLAFDIETLYHEGEFGTGPILMISYADGSEARVITWKKIDLPI
VDVVSTEKEMIKRFLRVVREKDPDLIT^YNGDNFD^FAYLKKRCEELGIKFTLGRDGSEPK
IORMGDRFAVEVKGRIHFDLYPVIRRTINLPT^YTLEAVYEAVFGKPKEKVYAEETIAQAW
SGEGLERVARYSMEDAKVTYELGREFFPME^AQLSRLIGQSLWDVSRSTGNLVEWFLLRK
AYKRNELAPNKPDERELARRRGYAGGYVKEPERGLWDNIVYLD^FRSLYPSIIITHNVSP
DTLNREGCKEYDVAP^EVGHKFC^KDFPGFI^PSLLGDLLEERQKIKRKM^KATVDPLEKKLLD
YRQRAIKILANSFYGYGYAKARWYCKE^CAE^SVTAWGREYIEMVIRELEEKFGFKVLYAD
TDGLHATIPGADAE^TVKKKAKEFLKYINPKLPGLLELE^EYEGFYVRGFFVTKKKYAVIDEE
GKITTRGLEIVRRDWSEIAKETQARVLEAILKHGDVEEA^VRI^VKEVTEKLSKYEVPP^EKL
VIHEQITRDLRDYKATGPHVAVAKRLAARGVKIRPGTVISYIVLKGSGRIGDRAIPADEF
DPTK^HRYDAEYYIENQVLP^AVERILKAFGYRKEDLRYQ^KTKQVGLGAWLKVKGKK

FIG. 53

Vent polymerase UniProtKB - P30317 (DPOL_THELI) (SEQ ID NO:141)

MILDTDYITKDGKPIIRIFKKENGFEKIELDPHFQYIYALLKDDSAIEEIKAIKGERHGKTVRVLDVAVK
VRKKFLGREVEVWKLI FEHPQDVPAMRGKIREHPAVVDIYEYDIPFAKRYLIDKGLIPMEGDEELKLLAF
DIETFYHEGDEFKGEIIMISYADEEEARVITWKNIDL PYVDVVSNEREMIKRFVQVVKEDPDVITYN
GDNFDLPYLKRAEKLGVRLVLRDKEHPEPKIQRMGDSFAVEIKGRIHFDLFPVVRTINLPTYTLEAV
YEAVLGKTKSKLGAEFIAATWETEE SMKLAQYSMEDARATYELGKEFFPMEAFIAKLIGQSVWDVSRSS
TGNLVEWYLLRVAYARNELAPNKPEDEEYKRRRLRTTYLGGYVKEPEKGLWENIIYLDFRSLYPSIIVTHN
VSPDTLEKEGCKNYDVAPIVGYRFCKDFPGFIP SILGDLIAMRQDIKKMKSTIDPIEKKMLDYRQRAIK
LLANSILPNEWLP I IENGEIKFVKIGEFINSYMEKQKENVKTVENTEVLEVNNLFAFSFNKKIKESEVKK
VKALIRHKYKGKAYEIQLSGGRKINITAGHSLFTVRNGEIKEVSGDGIKEGDLIVAPKKIKLNEKGV SIN
IPELISDLSEETADIVMTISAKGRKNFFKGMRLRTLWMFGEENRRIRTFNRYLPHLEKLGLIKLLPRGY
EVTDWERLKKYKQLYEKLAGSVKYNKREYLVMFNEIKDFISYFPQKELEEWKIGTLNGFRTNCLLKVD
EDFGKLLGYVYVSEGYAGAQNKTGGISYSVKLYNEDPNVLESMKNVAEKFFGKVRVDRNCVSI SKKMAYL
VMKCLCGALAE NKRIPSVILTSPEPVRWSFLEAYFTGDGDIHPSKRFRSLTKSELLANQLVFLNLSLGIS
SVKIGFDSGVYRVYINEDLQFPQTSREKNTYYSNLIPKEILRDVFGKEFQKNMTFKKFKELVDSGKLNRE
KAKLLEFFINGDIVLDRVKS VKEKDYEGYVYDLSVEDNENFLVGFGLLYAHNSYGYMGYPKARWYSKEC
AESVTAWGRHYIEMTIREIEEKFGFKVL YADSVSGESEIIIRQNGKIRFVKIKDLFSKVDYSIGEKEYCI
LEGVEALTLD DDGKLVWKPVYVMHRANKRMFR IWL TNSWYIDVTEHSLIGYLN TSKTKTAKKIGERL
KEVKPFELGKAVKSLICPNAPLKDENTKTSEIAVKFWELVGLIVGDGNWGGDSRWAEYYLGLSTGKDAEE
IKQKLEPLKTYGVISNYYPKNEKGDFN ILAKSLVKFMKRHF KDEKRRKIPEFMYELPVTYIEAFLRGL
FSADGTVTIRKGVPEIRLTNIDADFLREV RKLLWIVGISNSIFAETTPNRYNGVSTGTSYSKHLRIKKNWR
FAERIGFLIERKQKRLLLEHLKSARVKRNTIDFGFDLVHVKKVEEIPYEGYVYDIEVEETHRFFANNILVH
NTDGFYATIPGEKPELIK KKAKEFLNYIN SKLPGLLELEYEGFYLRGFFVTKKRYAVIDEEGRITTRGLE
VVRD WSEIAKETQAKVLEAILKEGSVEKAVEVVRDVVEKIAKRVPLEKLV IHEQITRDLKDYKAIGPH
VAIAKRLAARGIKVKPGTII SYIVLKGSGKISDRVILLTEYDPRKHKYDPDYIENQVLPVLRILEAFG
YRKEDLRYQSSKQTGLDAWLKR

FIG. 54

Deep Vent polymerase UniProtKB - Q51334 (DPOL_PYRSD) (SEQ ID NO:142)

MILDADYITEDGKPIIRIFKKENGFEKVEYDRNFRPYIYALLKDDSQIDEVRKITAERHG
KIVRIIDAEKVRKKFLGRPIEVWRLYFEHPQDVPAIRDKIREHSAVIDIFEYDIPFAKRY
LIDKGLIPMEGDEELKLLAFDIETLYHEGEFFAKGPIIMISYADEEEAKVITWKKIDLPI
VEVSSEREMIKRFLKVIREKDPDVIITYNGDSFDLPYLVKRAEKLGIKPLGRDGSPEK
MQRLGDMTAVEIKGRIHFDLYHVIRRTINLPTYTLEAVYEAFGKPKKEKVVAAHEIAEAW
TGKGLERVAKYSMEDAKVTYELGREFFPMEAQLSRLVGQPLWDVSRSTGNLVEWYLLRK
AYERNELAPNKPDEREYERRRLRESYAGGYVKEPEKGLWEGLVSLDFRSLYPSIIITHNVS
PDTLNREGCREYDVAPEVGHKFCCKDFPGFIPSLKRLLLDERQEIKRKMASKDPIEKKML
DYRQRAIKILANSILPEEWVPLIKNGKVKIFRIGDFVDGLMKANQKVKKTGDTTEVLEVA
GIHAFSFDRLKSKKARVMKAVIRHRYSGNVYRIVLNSGRKITTTEGHSLFVYRNGDLVE
ATGEDVKIGDLLAVPRSVNLPEKRELRNIVELLLNLSPEETEDIILTI PVKGRKNFFKGM
LRTLRIWIFGEEKRVRTASRYLRHLENLGYIRLRKIGYDIDKEGLEKYRTL YEKLVDVVR
YNGNKREYLVFNVRDVI SLMPEEELKEWRIGTRNGFRMGTFVDIDEDFAKLLGYVSE
GSARKWKNQTGGWSYTVRLYNENDEVLDMEHLAKKFFGKVKRGKNYVEIPKKMAYIIFE
SLCGTLAENKRVPEVIFTSSKGVRAWFLEGYFIGDGDVHPSKRVRLSTKSELLVNGLVLL
LNSLGVSAIKLGYDSGVYRVYVNEELKFTEYRKKKNVYHSHIVPKDILKETFGKVFQKNI
SYKKFRELVENGLDREKAKRIEWLLNGDIVLDRVVEIKREYYDGYVYDLSVDEDEENFLA
GFGFLYAHNSYYGYGAKARWYCKEASVTAWGREYIEFVRKELEEKFGFKVLYIDTD
GLYATIPGAKPEEIKKKALEFVDYINAKPLGLELEYEGFYVRGFFVTKKKYALIDEEGK
IITRGLEIVRRDWSEIAKETQAKVLEAILKHGNVEEAAVKIVKEVTEKLSKYEIPPEKLV
YEQITRPLHEYKAI GPHVAVAKRLAARGVKVRPGMVGIVIVLRGDGPISKRAILAEFFDL
RKHKYDAEYYIENQVLPVAVLRILEAFGYRKEDLRWQTKQTGLTAWLNIKKK

FIG. 55

Therminator polymerase (SEQ ID NO:143)

MILDTDYITENGKPVIRVFKKENGEEFKIEYDRTFEPYFYALLKDDSAIEDVKKVTAKRHG
TVVKVRAEKVQKKFLGRPIEVWKL YFNHPQDVPAIRDRI RAHPAVVDIYEYDIPFAKRY
LIDKGLIPMEGDEELTMLAFATLYHEGEFFGTGPILMI SYADGSEARVITWKKIDLPY
VDVSTEKEMIKRFLRVREKDPDVLITYNGDNFDFAYLKKRCEEELGKFTLGRDGSPEK
IQRMGDRFAVEVGRIHFIDLYPVIRRTINLPTYTLEAVYEAVFGKPKKQVYAEELAQAW
SGEGLERVARYSMEDAKVTYELGREFFPMEAQLSRLIGQSLWDVSRSSSTGNLVEWFFLLRK
AYKRNELAPNKPDERELARRRGGYAGGYVKEPEFERGLWDNIVYLDFRSLYPSIIITHNVSP
DTLNREGCKEYDVAPEVGHKFCCKDFPGFIPSLIGDLLLEERQKIKRKMKA TVDPLEKKLLD
YRQRLIKILANSFYGYGYAKARWYCKEAE SVTAWGREYIEMVIRELEEKFGFKVLYAD
TDGLHATIPGADAE TVKKKAKEFLKYINPKLPGLLELEYEGFYVRGFFVTKKKYAVIDEE
GKITTRGLEIVRRDWSEIAKETQARVLEAILKHGDVEEAVRIVKEVTEKLSKYEVPPPEKL
VIHEQITRDLDYKATGPHVAVAKRRLAARGVKIRPGTVISYIVLKGSGRIGDRAIPADEF
DPTKHRDYAEYYIENQVLP AVERILKAFGYRKEDLRYQTKQVGLGAWLKVKGKK

FIG. 56

Pfu polymerase UniProtKB - P61875 (DPOL_PYRFU) (SEQ ID NO:144)

MILDVDYITEEGKPVIRLFKKENGKFKIEHSDRTFRPYIYALLRDDSKIEEVKKITGERHG
KIVRIVDVEKVEKKFLGKPI TVWKLYLEHPQDVPTIREKVRHPAVVDIFEYDIPFAKRY
LIDKGLIPMEGEEELKILAFDIETLYHEGEEFGKGPIMI SYADENEAKVITWKNIDL PY
VEVSSEREMIKRFLRIIREKDPDIIVTYNGDSFDFPYLAKRAEKLIGIKLTIGRDGSEPK
MQRIGDMTAVEVGRIHFIDL YHVI TRTINLPTYTLEAVYEAI FGKPKVKYADEIAKAW
SGENLERVAKYSMEDAKATYELGKEFLPMEIQLSRLVGQPLWDVSRSSGTGNLVEWFLLRK
AYERNEVAPNKPSEEEYQRRRLRESYTGGFVKEPEKGLWENIVYLDFRALYPSIIITHNVS
PDTLNLEGCKNYDIAPQVGHKFCKDIPGFI PSLLGHLLEERQKIKTKMKETQDPIEKILL
DYRQKAIKLLANSFYGYGAKARWYCKEAE SVTAWGRKYIELVWKELEEKFGFKVLYI
DTDGLYATIPGGESEEEKKKALEFVKYINSKLPGLLELEYEGFYKRGFFVTKKRYAVIDE
EGKVITRGLEIVRRDWSEIAKETQARVLETILKHGDVEEA VRIVKEVIQKLANYEIPPEK
LAIYEQITRPLHEYKAIGPHVAVAKKLAAGVKIKPGMVIGYIVLRGDGPISNRAILAE
YDPKKHKYDAEYIENQVLPVAVLRILEGFGYRKEDLRYQKTRQVGLT SWLNIKKS

FIG. 57

Pyrococcus abyssi polymerase UniProtKB - P0CL77 (DPOL_PYRAB) (SEQ ID NO:145)

MIIDADYITEDGKPIIRIFKKEKGEFKVEYDRTRFYIYALLKDDSAIDEVKKITAEHRG
KIVRITEVEKVQKKFLGRPIEVWKLYLEHPQDVPAREKIREHPAVVDIFEYDIPFAKRY
LIDKGLTPMEGNEELTFLAVDIETLYHEGEFFGKGPIIMISYADEEGAKVITWKSIDLPI
VEVSSEREMIKRLVKVIREKDPDVIITYNGDNFDFPYLLKRAEKLGIKPLGRDNSEPK
MQRMGDSLAVEIKGRIHFDLFPVIRRTINLPTYTLEAVYEAFGKSKEKVYAHEIAEAW
TGKGLERVAKYSMEDAKVTFFELGKEFFPMEAQLARLVGQPVWDVSRSTGNLVEWFLLRK
AYERNELAPNKPDEREYERRLRESYEGGYVKEPEKGLWEGIVSLDFERSLYPSIITHNVS
PDTLNRENCKEYDVAPQVGHRECKDFPGFIPSLLGNLLEERQKIKKRMKESKDPVEKKLL
DYRQRAIKILANSYGYGYAKARWYCKECAESVTAWGRQYIDLVRRELESRGFKVLYID
TDGLYATIPGAKHEEIKEKALKFVEYINSKLPGLLELEYEGFYARGFFVTKKKYALIDEE
GKIVTRGLEIVRRDWSEIAKETQAKVLEAILKHGNVDEAVKIVKEVTEKLSKYEIPPEKL
VIYEQITRPLSEYKAIGPHVAVAKRLAAKGVKPGMVIYIVLRGDGPISKRAIAIEEF
DPKKHKYDAEYYIENQVLPVERILRAFGYRKEDLKYQKTKQVGLGAWLKF

FIG. 58

RB69 polymerase UniProtKB - Q38087 (DPOL_BPR69) (SEQ ID NO:146)

MKEFYLTVEQIGDSIFERYIDSNGRERTREVEYKPSLFAHCPESQATKYFDIYGKPCTRK
LFANMRDASQWIKRMEDIGLEALGMDDFKLAYLSDTYNYEIKYDHTKIRVANFDIEVTSP
DGFPEPSQAKHPIDAITHYDSIDDRFYVFDLLNSPYGNVEEWSIEIAAKLQEQGGDEVPS
EIIDKIIYMPFDNEKELLMEYLNFWQQTPIVLTGWNVESFDIPYVYNRIKNIIFGESTAK
RLSPHRKTRVKVIENMYGSREIITLFGISVLDYIDLKKEFSFTNQPSYSLDYISEFELNV
GKLYDGPISKLRSENHQRYISYNIIDVYRVLQIDAKRQFINLSLDMGYAKIQISVFS
PIKTWDAAIFNSLKEQNKVIPOGRSHPVQYPGAFVKEPIPNRYKYVMSFDLTSLYPSII
RQVNI SPETIAGTFKVAPLHDYINAVAERPDSVYSCSPNGMMYYKDRDGVVPTETTKVFN
QKKEHKGMYLAAQRNGEIIKEALHNPNLVDEPLDVDYRDFSDEIKEKIKKLSAKSLNE
MLFRAQRTEVAGMTAQINRKLLINSLYGALGNVWFRYYDLRNATAITTFGQMALQWIERK
VNEYLNEVCGTEGEAFVLYGDTDSIYVSADKIIDKVGESKFRDTNHWVDFLDKFEARERME
PAIDRGFREMCEYMNNKQHLMFMDREAIAAGPPLGSKGIGGFTGKKRYALNVWDMEGTRY
AEPKLKIMGLETQKSSTPKAVQKALKECIRMLQEGEESLQEFKFEFEFRQLNYISIA
SVSSANNIAKYDVGGFPKCPFHIRGILTYNRAIKGNIDAPQVVEGEKVYVLPPLREGNP
FGDKCIAWPSGTEITDLIKDDVLHWM DYTVLLEKTFIKPLEGFTSAAKLDYEKKASLFDM
FDF

FIG. 59

Bacteriophage T3 DNA ligase NCBI No. NP_523305.1 (SEQ ID NO:147)
Cai 2004 Journal of Biochemistry 135:397-403;

MNIFNTNPFKAVSFVESAVKKALETSGYLIADCKYDGVRGNI VVDNVAEAAWLSRVSKFI
PALEHLNGFDKRWQQLLNDDRCIFPDGFMLDGELMVKGVDENTGSGLLRTKWVKRDNMGF
HLTNVPTKLT PKGREVIDGKFEFHLDPKRLSVRLYAVMPTIHIAESGEDYDVQNLLMPYHV
EAMRSLLEVYFPEIEWLIAET YEVYDMSLTLEYEEKRAEGHEGLIVKDPQGIYKRGGKS
GWKKLKECEADGIIQGVNWGTEGLANEGKVI GFSVLTETGRLVDANNI SRALMDEFTSN
VKAHGEDFYNGWACQVNYMEATPDGSLRHPSFEKFRGTEDNPQEKM

FIG. 60

Bacteriophage T4 DNA ligase NCBI No. NP_049813.1 (SEQ ID NO:148)
Miller 2003 Microbiology Molecular Biology Review 67:86-156;

MILKILNEIASIGSTKQQAILEKNKDNELLKRVYRLTYSRGLQYYIKKWPKPGIATQSF
GMLTLTDMLD FIEFTLATRKL TGNA AIEELTGYITDGKKDDVEVLRVMRDLCEGASVS
IANKVWPGLIPEQPQMLASSYDEKGINKNIKFPAPAQLKADGARCFAEVRGDELDDVRLL
SRAGNEYIGLDLLKEELIKMTAEARQIHPEGVLIDGELVYHEQVKKEPEGLDFLFDAYPE
NSKAKEFAEVAESRTASNGIANKSLKGTISEKEAQCMKFQVWDYVPLVEIYSLPAFRLKY
DVRFSKLEQMTSGYDKVILIENQVVNNLDEAKVIYKKYIDQGLEGIILKNIDGLWENARS
KNLYKFEKVIDVDLKI VGIYPHRKDPTKAGGF ILESECGKIKVNAGSGLKD KAGVKSHL
DRTRIMENQNYIYGKILECECNGWLKSDGRTDYVKLFLPIAIRLEDKTKANTFEDVF GD
FHEVTGL

FIG. 61

Bacteriophage T7 DNA ligase NCBI No. NP_041963.1 (SEQ ID NO:149)
Dunn and Studier 1983 Journal of Molecular Biology 166:477-535

MN I K T N P F K A V S F V E S A I K K A L D N A G Y L I A E I K Y D G V R G N I C V D N T A N S Y W L S R V S K T I P
A L E H L N G F D V R W K R L L N D D R C F Y K D G F M L D G E L M V K G V D F N T G S G L L R T K W T D T K N Q E F H
E E L F V E P I R K K D K V P F K L H T G H L H I K L Y A I L P L H I V E S G E D C D V M T L L M Q E H V K N M L P L L
Q E Y F P E I E W Q A A E S Y E V Y D M V E L Q Q L Y E Q K R A E G H E G L I V K D P M C I Y K R G K K S G W W K M K P
E N E A D G I I Q G L V W G T K G L A N E G K V I G F E V L L E S G R L V N A T N I S R A L M D E F T E T V K E A T L S
Q W G F S P Y G I G D N D A C T I N P Y D G W A C Q I S Y M E E T P D G S L R H P S F V M F R G T E D N P Q E K M

FIG. 62

Thermal stable Tfu DNA ligase (Thermococcus fumicolans) UniProtKB/Swiss No. Q9HH07.1 (SEQ ID NO:150)
Rolland 2004 FEMS Microbiology Letters 236(2):267-273

M K Y S E I A G L Y R R L E K T T L K T L K T R F V A D F L K N V P D E L L E I V P Y L I L G K V F P D W D E R E L G V
G E K L L I K A V S I A T G V P E G E I E N S I K D T G D L G E S I A L A V K K K Q K S F F S Q P L T I K R V Y D T F
V K V A E S Q G E G S Q D R K M K Y L A N L F M D A Q P E E A K Y I A R T V I G T M R T G V A E G I L R D A I A E A F K
V K A E L V E R A Y M L T S D F G Y V T K V A K L E G N E G L S K V R I Q V G K P V R P M L A Q N A A S V K D A L L E M
G G E A A F E I K Y D G A R V Q V H K D G D R V I Y S R R L E N V T R S I P E I V E A V R S Q L R P E K A I V E G E L
V A V G D G G K P R P F Q Y V I R R F R R K Y N I E E M I E R I P L E L N L F D V L Y V D G E S L V D T P F M E R R K R
L E E A V E E S E R I K L A Q Q L V T K K A E E A E E F Y R R A L E L G H E G L M A K R L D S V Y E P G N R G K K W L K
I K P T M E D L D L V I I G A E W G E G R R A H L L G S F L V A A Y D Q H R G E F V P V G K V G S G F T D E D L A E F T
K M L K P L I V R E E G K Y V E I E P R V V I Q V T Y Q E I Q K S P K Y E S G F A L R F P R Y V A L R E D K S P E E A D
T I E R I S E L Y G L Q E R F K A K R

FIG. 63

Thermal stable DNA ligase from *Thermococcus nautili* NCBI No. WP_042693257.1 (SEQ ID NO:151)

MKYS ELAE L YRRLEK T T L K T K F V A D F L K K T P D D L L E I V P Y L I L G K V F P D W D E R E L G V
GEK L L I R A V S M A T G V P E R E I E N S I K D T G D L G E S V A L A K K R K Q K S F F S Q P L T I K R V Y S T F
V K V A E A S G E G S Q D R K M K Y L A N L F M D A Q P E E G K Y I A R T V L G T M R T G V A E G I L R D A I A E A F K
V K P E L V E R A Y M L T S D F G Y V A K V A K L E G N E G L S K V S I Q I G K P I R P M L A Q N A A N V K E A L I E M
G G E A A F E I K Y D G A R V Q V H R D G D R V I I Y S R R L E N V T R S I P E I V E A V K A S L K P S K V I V E G E L
V A V G E N G R P R P F Q Y V L R R F R R K Y N I E E M I E K I P L E N L F D I L Y V D G E S L I D T K F A E R R K K
L E E S V E E S D K I K L A E Q L V T K K V E E A E E F Y K R A L E L G H E G L M A K R L D S I Y E P G N R G K K W L K
I K P T M E N L D L V I I G A E W G E G R R A H L L G S F L V A A Y D P E S G E F V P V G K V G S G T D E D L V E F T
K M L K P L I V R E E G K F V E I E P K V V I E V T Y Q E I Q K S P K Y K S G F A L R F P R Y V A L R E D K S P E E A D
T I E R V A Q L Y E L Q E R F K A K R

FIG. 64