Sustainable Circular Track Line Network

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of International Patent Application No. PCT/CN2012/075257 with an international filing date of May 9, 2012, designating the United States, now pending, and further claims priority benefits to Chinese Patent Application No. 201110128735.9 filed on May 10, 2011. The contents of all of the aforementioned applications, including any intervening amendments thereto, are incorporated herein by reference. Inquiries from the public to applicants or assignees concerning this document or the related applications should be directed to Matthias Scholl P.C.,Attn.: Dr. Matthias Scholl Esq.,14781 Memorial Drive, Suite 1319, Houston, TX 77079.

BACKGROUND OF THE INVENTION

[0002] Field of the Invention

[0003] The invention relates to a railway route-system and line/network planning, and more particularly to the structure of multi-track turnouts, junctions and stations, and inside which switch-compages.

[0004] Description of the Related Art

[0005] A railway network is the foundation of vehicles' operation. However, Metro and Regional lines (RER) mainly adopt Back-and-Forth (BF) routing, disconnecting each other, allowing no vehicles' transfer but only passengers'

interchange on-foot. Traditional fork-lines cored by 从-shaped (FIG.11-YX) turnouts or similar, remain compound BF routing, causing traffic flows in both branches cut by half, and therefore fail in continuous branching. Although connected by complex junctions, the Inter-City railway (IC) is bond to too many switches and crosses (i.e. red-lights), to dispatch continuous train-shifts local and express.

[0006] Moreover, both IC and Metro rely mainly on general traffics for feeder- ship. Stations become larger when bus/taxi stations and car parking gather all around, resorting crowds and causing disorder or even jams.

[0007] In summary, based on the traditional full-return routing, lines can hardly connect each other by existing turnouts or junctions, while keeping traffic flow saturate and balanced, let alone reorganizing multi-way trains; and rail-transit in general can hardly expand its service layover to replace general traffics.

SUMMARY OF THE INVENTION

[0008] In view of the above described problems, it is one objective of the invention to break through the full-return routing in disconnected or stiffly connected lines/networks; and instead, to employ circulating route-system in the properly connected sustainable lines/networks, including the poly-rails feeder-lines/nets derived; and in this way, improving rail-transit service layover, safety and efficiency in general.

[0009] To achieve the above objective, and in accordance with one embodiment

of the invention, provided is fundamentally a sustainable railway network, which comprises circular-turnouts covered by multi-way stations, as cores and/or key nodes of the circulating lines/networks and of the feeder-lines/nets derived; which employs the circulating route-system to minimize red-lights, enhance and balance multi-way traffic flow; which facilitates vehicles' interchange and reorganizing, and passengers' on-board and/or easy transfer; and which improves service layover, safety and efficiency in general, and effectively reduces the building and operating cost of the railway network.

[0010] A circular-turnout comprises at least three multi-connected BF ports, and at least one set of at least three-way circular V-ramps or tracks, facilitating at least tri-directional vehicles turning from the Back-track of each BF port into the Forth-track of the same (right or left) side nearby BF port, completing a circulation.

[0011] In a class of this embodiment, the V-ramp is compound of multiple ramps, assembling a crescent shaped junction; the flat bottom V-track with two ramps comprises a serial of two Crescent Junctions (VCJ).

[0012] The Crescent Junction(VCJ) is one-way-through, restricting all ramps inside unidirectional and non-crossing each other, comprising an Overtaking Track (OT) by its shorter and less-curved side, Platform-Tracks (PT) by its longer and more-curved side, and a Train-Yard (TY) in between.

[0013] In a class of this embodiment, the circular-turnout is a poly-rails turnout, comprising at least three multi-connected Bf or bF or BF or bf ports, and at least one set of at least three-way V or v-ramps of at least two rail-types in circulation.

[0014] In a class of this embodiment, the circular-turnout is a hollow-star

turnout, comprising at least one set of at least four-way V-ramps/tracks in circulation, connecting at least four BF=trunks.

[0015] In a class of this embodiment, the circular-turnout is a switchable turnout, cored by at least one set of T-link, connecting at least two BF=trunks. The T-link comprises at least one d-m ramp across T-shoulders in horns' shape, connecting one BF port at T-foot. The d-m ramp is one-way, starting from a diverging-switch and ending by a merging-switch, both d/m switches irreversible with fork-angles outpointing.

[0016] In a class of this embodiment, the circular-turnout is a circular-switchable turnout, comprising at least one set of at least three-way V-ramps/ tracks totally inserted by the d-m ramps or D-M tracks; connecting at least three totally BF=trunks.

[0017] In a class of this embodiment, the d-m ramp or D-M track is restricted within the turnout range, and by its ship lock structure, employs four ways of switching: d/m both-on, d-on/m-off, d-off/m-on, d/m both-off. As a result, the switchable turnout or circular-switchable turnout enjoys at least one switch-frozen model, during which period at least one d-m both-off ramp/ track is modified into a parking lot or shuttle-line, without interfering rest of the traffic inside the turnout.

[0018] The multi-way station is a station or a group of sub-stations covering a circular-turnout, including a station or sub-station covering a poly-rails turnout or poly-rails hub. The poly-rails hub comprises at least one circular-turnout made of at least one rail-type.

[0019] In a class of this embodiment, a multi-way station comprises at least one multi-lateral platform with at least three boarding sides, for trains of at

least one rail-type; and which is monolayer or split-leveled or connected by split-level passages.

[0020] In a class of this embodiment, the multi-way station facilitates passengers' circular-transfer, when at least three trains of at least one rail-type synchronously stop by the multi-lateral platform in a heads-by-ends manner, and one-step-transfer between the parallel coaches heads-by-ends.

[0021] The circulating-lines/networks comprise semi-return circulating-lines and non-return circulating-networks. The circulating-line/lines or existing BF line/lines or both together, may be modified or merge into one circulating-network, when their peripheral terminals further connected by additional circular-turnouts into an outer circle.

[0022] In a class of this embodiment, the circulating line including a tree line, or a hollow star line, or a polygonal interchange line, or a circle-radial line, comprises at least one circular-turnout, connecting at least three BF=sections, among which at least two BF=trunks; at least part of vehicles semi-return from and circulate among at least three terminals.

[0023] In a class of this embodiment, the circulating network is a circles-combination, comprising at least one inner-rings-combination of monolayer or grade-separated. The monolayer inner-rings-combination comprises at least two rings of same rotation, which is split-able internally or attachable externally. The grade-separated inner-rings-combination is duplicable in two or four or six directions, comprising at least one self-cross-loop, or at least one self-cross-loop plus at least one ring of same rotation. The self-cross-loop comprises at least three open-end rings of same rotation.

[0024] In a class of this embodiment, the circulating line/network is a feeder-line or feeder-net of a miner rail-type; the feeder-line covers or braids at least

one major rail-type, resulting in poly-rails hub/hubs and poly-rails section/sections; the feeder-net inserts or threads the circular-turnout/turnouts of at least one major rail-type, resulting in poly-rails turnouts or poly-rails hubs and poly-rails sections. The feeder-net is an inner-ring or inner-rings-combination, including a polygonal inner-rings-combination; which comprises at least two inner-rings of same rotation connected in alternate angles, and the inside ring is still replace-able by an inner-rings-combination.

[0025] In a class of this embodiment, the poly-rails hub comprises at least two rail-types, and at least one set of V or v-ramps of at least one rail-type; including a Candlestick-hub or Kite-hub or Star-hub or a 个/大/木-hub.

[0026] In a class of this embodiment, the poly-rails section comprises at least two rail-types of different capacity, shifts and stops, and at least parallel and bidirectional double tracks, including Bf-bF anti-way feeding section and b-BF-f same-way feeding section.

[0027] In a class of this embodiment, the feeder-net is a Circular-Shuttles (CnS) line in an ever closed inner ring of flexible rotation, comprising at least three trains dividable and reorganize-able. When inserted between the nV or nYX turnout of a rapid-rail and nc inner-rings-combination of a light-rail, the CnS line employs same-way feeding or circular-transfer with the outside rapid-rail or the inside light-rail, or keep off from the both side rails' circular-transfer.

[0028] A sustainable railway network of a second embodiment of the invention, comprising circular-turnouts and/or plate-turnouts, covered by multi-way stations, as cores and/or key nodes of circulating lines/networks, including feeder-lines/nets derived, employs circulating route-system to minimize red-lights, enhance and balance traffic flows; and facilitates vehicles' interchange and reorganizing, and passengers' on-board and/or easy transfer.

[0029] In a class of this embodiment, the plate-turnout comprises at least one circular-plate; the circular-plate is a double-track plate or a triple-track plate, facilitating bidirectional or tri- directional vehicles to pass through or circular-switch.

[0030] In a class of this embodiment, the circular-plate is a suspended plate of a pot-cover shape, comprising double or triple track-slots fixed underneath the plate, facilitating bidirectional or tri-directional suspended vehicles to pass through or circular-switch.

[0031] In a class of this embodiment, the circulating line/network employs at least one plate-frozen model, during which period the both ends plate-off BF= section is modified into a double-shuttles line, and the at least three ends plate-off sections are modified into an at least triple-shuttles line, without interfering rest of the traffic in the circulating line/network.

[0032] Advantages of the invention comprise:

[0033] 1) The circular-turnouts serving as cores and/or key nodes of the circulating lines/networks, employ circulating route-system to minimize red lights, enhance and balance multi-way traffic flows, facilitate vehicles' inter-change and reorganizing, and sustainable branching and expanding of the multi-track lines/networks,.

[0034] 2) The multi-way station or sub-stations, directly covering the circular-turnouts, spreading out to balance the crowd, facilitate passengers' on-board and/or easy transfer, with more choices of routing.

[0035] 3) Based on the circulating route-system, the circulating lines/networks including the poly-rails feeder-lines/nets derived, improve the

rail-transit service layover, safety and efficiency in general; and in this way, replace the general traffics to reduce their pollution and jams.

[0036] 4) Since all double-track sections remain in use, all stations within two layers of space, all dispatching and scheduling optimized by simplified and concentrated junctions; the circulating lines/networks is sustainable to reduce the building and operating cost.

BRIEF DESCRIPTION OF THE DRAWINGS

~~[0037]~~ FIG.1 is a schematic view of the circulating lines/networks, locations of turnouts and hubs, modification and poly-rails feeder-ship.

[0038] FIG.2 shows the structure of a 4VX, or 4V+, or 8V hollow-star-turnout.

[0039] FIG.3 magnifies the Yv/T2v turnout and Bf=bF section of FIG.1.

[0040] FIG.4 shows the structure of 2YT and I-shaped turnout in a 4V tree-line.

[0041] FIG.5 shows the structure of a YT station, platforms and VCJs.

[0042] FIG.6 shows vehicles' interchange and re-organizing and passengers' transfer in the TZ-turnout/station.

[0043] FIG.7 shows vehicles' interchange and re-organizing and passengers' transfer in the T-turnout/station.

[0044] FIG.8 shows vehicles' interchange and re-organizing in the Y3T turnout/station.

[0045] FIG.9 shows a 4YT tree-line and its further modification into an A/4C circles-combination.

[0046] FIG.10 magnifies FIG.1- T8/T16, showing the structure of a poly-rails Candlestick-hub.

[0047] FIG.11 is the sketch map of a triangle or hexagonal cross-interchange turnout.

[0048] FIG.12 shows the square or octagonal cross-interchange turnout, structure of c1 feeder-net and 4YXv turnouts/sub-stations.

[0049] FIG.13 magnifies FIG.12-Xv, showing the structure of a YXv turnout/ sub-station.

[0050] FIG.14 shows the 4T and 4VCJ structure and 4P multi-lateral platforms, in a kite-hub and covering station.

[0051] FIG.15 shows the structure of a hexagonal through-interchange hub.

[0052] FIG.16 shows the c1/4/5 inner-rings threading a compound 4V and a kite-turnout, and their modification into a polygonal inner-rings combination.

[0053] FIG.17 magnifies FIG.15-Mu, showing the structure of 个/大/木 -hub.

[0054] FIG.18 is a sketch map of the Cable-Cars' circles-combination.

[0055] FIG.19 is a sketch map of a Monorail's circles-combination, and the central part shows a six-way star-hub.

[0056] FIG.20 shows vehicles' interchange and reorganizing in a triple-track plate-turnout.

[0057] FIG.21 shows vehicles' interchange and reorganizing in a double-track plate-turnout.

[0058] FIG. 22 shows the suspended turn-plate of a pot-cover shape, carrying bidirectional suspended vehicles.

[0059] FIG. 23 shows the C'1/C2 inner-rings-combination duplicable in two directions.

[0060] FIG. 24 modifies some turnouts of FIG. 23 into the plate-turnouts.

[0061] FIG. 25 shows locations of the 4v+M(2BF+) poly-rails kite-hubs, and monorail's inner-rings-combination duplicable in four directions.

[0062] FIG. 26 modifies some turnouts of FIG. 25 into the plate-turnouts.

[0063] FIG. 27 magnifies FIG.25-4v+M, showing structure of the poly-rails kite-hub.

[0064] FIG. 28 shows structure of the poly-rails eight-way star-hub.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0065] Detailed description will be given below in conjunction with drawings and embodiments accompanying.

[0066] Metro or RER lines can hardly pass through a square city in the

X-ways; while FIG.1-T2/T6/T10/T14 shows a four-terminal line connected by a hollow-X-shaped turnout 4Yv, taking advantage of four sides' streets to avoid central district. In this way, all trains online circulate among T2-T14-T10-T6-T2 and four double-track sections through the central 4Yv turnout.

[0067] As shown by FIG.2/4-8/11-12/14-15, and always from central point of view, a circular-turnout comprises at least three multi-connected Back-and-Forth (BF) ports, and at least one set of at least three-way V-turn ramps or tracks, facilitating vehicles turning from the Back track of each BF port into the Forth- track of the same(right or left) side nearby BF port, completing an at least three-way circulation, such as B1-F3/ B3-F2/B2-F1 in FIG.5.

[0068] In Fig.12 and magnified as Fig.13-FB3, the 4YX turnout comprises 4BF ports and two sets of 4V-tracks, outside 4Y turning left and inside 4X turning right. Although crossing each other, the 4X still structure a hollow-X 4V-tracks in circulation. The rapid-rail track in FIG.3-T2v is straight, and the outside corner V-ramp in Fig.18 even turns left; but still either track/ramp runs into the first **bF** or **bf** port on its right side, structuring a T2v or V2v circular-turnout.

[0069] FIG.4 shows an I-shaped 4V turnout, deriving two Y3V turnouts; the V1-4 or V3-2 ramp has a short and curved V-bottom; and the V4-3 or V2-1 track has a long and flat V-bottom, deriving a serial of two V-ramps.

[0070] In a class of this embodiment, as show by FIG. 5 and FIG. 12, a V-ramp is compound of parallel ramps non-crossing each other, assembling a

junction in crescent shape, namely a Crescent Junction (VCJ). FIG.10 and FIG.14 show that, a flat bottom V-track comprises a serial of two VCJs.

[0071] Shown by FIG. 5, the VCJ is one-way-through, comprising an Over-taking Ramp (OR) by its shorter and less curved side, Platform Tracks (PT) by its longer and more curved side, and a Train Yard (TY) in between.

[0072] In this way, multi-directional trains can be re-organized or replaced inside their own junctions, without interfering each other. Since at least two VCJs concentrated within one station range, they save land, equipments and manpower for management and maintenance.

[0073] In a class of this embodiment, as shown by FIG.1-2, four V-tracks T2-14- 10-6-2, or V-ramps V1-7-5-3-1 structure a 4VX hollow-X turnout, four V-ramps (V8-6-4-2-8) assemble a 4V+(X/+ mean bearings of 4BF) hollow-cross turnout; each connecting four BF=trunks (= means parallel/bidirectional connected) with equating traffic flows and free of switch or cross, i.e. free of red lights.

[0074] Accordingly, 3-n V-ramps make a 3-nV hollow-star turnout, such as the 8V (V8-7-6-5-4-3-2-1-8) in FIG.2, connecting 3-n BF=trunks with equating traffic flows. We classify above 4-nV as hollow-star turnouts, which are single- layer to saves space, avoid central obstacle and red-lights, therefore fitting a mass centre or transit-hub.

[0075] In a class of this embodiment, FIG.3-Yv shows a poly-rails turnout comprising at least three-way V- ramps/tracks of two rail-types, with at least three BF or Bf or bF or bf ports in circulation.

[0076] In a class of this embodiment, the circular-turnout is a switchable turnout or a circular-switchable turnout. The switchable turnout comprises at least one T-link cored by one d-m ramp in horns-shape as FIG.4/d4-m1 and magnified as d3-m1 in FIG.6-T. The circular-switchable turnout comprises at least one set of at least three way V-ramps/tracks totally inserted by d-m ramps as FIG.8 or by D-M tracks as FIG.11. The d-m ramp is one way through, starting from a diverge-switch and ending by a merge-switch, both switches irreversible with a pair of forking- angles out-pointing, and both restricted within the turnout range.

[0077] In a class of this embodiment, the d-m ramp is irreversible as shown by FIG.6; inside which all switches are marked **d** or **m**, except the one under Z-track, which is reversible as a merging-switch when a train enters Z-track, and as a diverging-switch when it exits.

[0078] In a class of this embodiment, owing to its ship-lock structure, the d-m ramp employs four switching ways: d/m both-on, d-on/m-off, d-off/m-on and d/m both-off. FIG.4 shows, a switchable turnout employs at least one switch-frozen model; during 2Y period the d/m both-off ramps d4-m1/d2- m3 are modified into parking lots, or during 2BF+2S period the d/m both-off tracks d4-m3/d2-m1 are modified into one double-shuttles (2S) line, without interfering rest of the traffic inside the turnout.

[0079] Shown by FIG.8-Y3T during the Y3V switch-frozen period, d/m both-off ramps d3-m1, d1-m2 and d2-m3 modified into parking lots for stand-by

trains 3R with both-side doors open, serving as walking bridges on the track-pitches. When all YT in FIG.1 frozen in Y3V model, there will be no switching or crossing in the network at all; then traffic flows may be enhanced by 180% in a balanced way (up to 72" per shift instead of present limit 2").

[0080] In a class of this embodiment, FIG.3-T2v shows a poly-rails turnout, with a light-rails' T-link connecting 2v and bf=branch, leaving the rapid-rails' track F-B not only free of switch, but also free of rail-type.

[0081] In a class of this embodiment, the circular-switchable turnout comprises at least one set of at least three V-ramps/tracks totally inserted by d-m ramps as FIG.8, or by D-M tracks as FIG.11. FIG.8-13 show a collection of the circular-switchable turnouts, each comprising at least one set of at least three-way V-ramps or tracks totally inserted by d-m ramps or D-M tracks, connecting at least three totally BF=trunks with equating traffic flows.

[0082] As shown by FIG.8/upper layer, when T-link d3-m1 tripled by two more T-links d1-m2 and d2-m3 with 120 deflection angle, structured is a Y3T-turnout; deriving d1-m3, d3-m2 and d2-m1 three d-m ramps totally inserting Y3V-ramps in circulation; connecting three BF=trunks with equating traffic flows. Besides the outside Y3V-ramps turning right in circulation, the 3T-ramps circular-turn left and cross each other, forming inside reveres circulation.

[0083] In a class of this embodiment, we classify T/TZ/Y3T shown by FIG. 6-8 as a YT turnout in general, which comprises at least one T-link cored by a

d-m ramp across T-shoulders, employs at least one switch-frozen model Y3V, connects at least two BF=trunks with traffic flows enhanced and balanced, and facilitates continuous branching by keeping at least one BF=trunk sustainable, as shown in FIG.9-4YT and FIG.1-8YT.

[0084] In a T turnout as FIG.6, the train approaching d3 separates into two parts, the Front part turns to branch through F2, the Rare part turns into d3-m1 ramp and after changing passengers, apical grafting BF2=Branch Returned part BR after m1 and before the post-T station, restoring full length to move on.

[0085] In this way, the T-foot BF=branch enjoys same train-shifts as in the BF=trunk across T-Shoulders, except coaches cut by half. Since passengers normally get less in a branch than a trunk, the branch stations and platforms can be half length as well; saving land and the building cost.

[0086] Nevertheless, the branch traffic flow can be balanced by supplementing a returning track Z (FIG.7), deriving d3- m2/d2-m1 ramps besides d3-m1; and in this way, the T turnout is modified into a TZ turnout.

[0087] Inside a TZ turnout (FIG.7), the branch-train breaks into two parts as well, its F part merges into the trunk at m1, its R part switches at d2 into Z-track, after changing passengers, returns at m2, waiting for the next F part from d3.

[0088] As shown by FIG.8, the Y3T turnout facilitates tri-directional trains'

circular-interchange by alternate switching 3d-on/3m-off before 3R trains' stop and 3d-off/3m-on afterwards; so that red-lights minimized. Moreover, a Y3T turnout connects totally three BF=trunks with equating traffic flows.

[0089] When three trains synchronously approach the Y3T turnout/station, each breaking into two parts, the 3F parts turn nearer sides non-stop, apical grafting the last-shift 3R' parts at three post-Y3T stations; the 3R parts turn further sides into d3-m1, d1-m2 and d2-m3 ramps, after changing passengers, forward to three post-Y3T stops, waiting for next-shift 3F parts. In this way, tri-directional trains are reorganized by circular-exchanging 3R parts.

[0090] Obviously, a switch-frozen model is free of red-lights, offering denser shifts and longer trains, especially during the rush-hours; in this way, enhancing and balancing multi-way traffic flows at least in continuous trunks.

[0091] Comparatively, present fork-lines cored by YX turnouts (FIG.13) are compound BF lines, connecting only one BF=trunk, causing train-shifts in 2BF= branches cut by half; and therefore, fail in continuous branching. Although it may facilitate F/R separating and restoring as in Spain and Japan, but never reorganization in circulation.

[0092] Taking Nanjing Metro Line1 for example, and supposing all 30 stops of equal time-distance; trains fully return between N=S or N=W by jumping shifts but never mix; 11 stops in N=YX trunk at 2'/shift, 15 stops in S=YX and 4 stops in W=YX, both branches at 4/shift; N=S/N=W 2/3 trips express, but S=W BF

trips transit up and down at pre-YX station; since 11/30+1/2 (15/30+4/30) =20.5/30, so the saturation of train-shifts in Line1 is about 68%.

[0093] If we change above YX into T turnout and take N=T=S as a continuous BF=trunk across T-shoulders and T=W at T-foot as branch, with train-length cut by half, then 11/30+15/30+1/2x4/30=28/30, so the saturation raised up to 93%. If half-trains in T=W not enough, we can still modify T into TZ turnout with 100% saturation. Both T/TZ turnouts keep 2/3 trips express, except N-S/ W-N door-to-door or just one-step transit at T/TZ station.

[0094] When the above T/TZ-foot BF=branch extending, we may further change T/TZ into Y3T turnout, connecting 3/3 BF=trunks to N/S/W with not only100% saturation, but also total trips express by on-board transfer.

[0095] Moreover, the YT turnouts facilitate continuous branching with traffic flows enhanced and balanced, by keeping at least N=S trunk sustainable; and in this way, improving Line1's service layover, safety and efficiency.

[0096] In a class of this embodiment, the circular-switchable turnouts for IC or RER are much larger. FIG.8-Y3T magnified by FIG.11-upper layer appears a 3YX triangle cross-interchange turnout, cored by D1-M3/D3-M5/ D5-M1 3T-links inside, and 3V- tracks totally inserted by D1-M5/D5-M3/D3-M1 outside. Double layers of 3YX in alternate angles connected by additional six d-m ramps: d-m4/d2-m5/d3- m6/d4-m1/d5-m2/d6-m3, assemble a 6YX hexagram turn- out, balancing traffic flows in 6BF=trunks towards six terminals.

[0097] Accordingly, FIG.12 upper-layer shows a 4YX square cross-interchange turnout. Double layers of 4YX in alternate angles, and connected by eight additional d-m ramps:d8-m5/d7-m4/d6-m3/d5-m2/d4-m1/d3-m8/d2-m7/ d1-m6, framing an 8YX octagonal turnout and connecting 8FB=trunks.

[0098] In above 6/8-way turnouts, 6-8 trains may each break into 3-4 parts, stopping along 3-4 sub-stations; once all parts follow the nD-nd...nm-nM order in circulation, same time at different points, or same points in different time, they cross-interchange and reorganize into 6-8 new trains synchronously.

[0099] Shown by FIG.14 and magnified by FIG.16-BF2/4/6/8, a kite-shaped turnout comprises one set of 4V-ramps or tracks totally inserted by d4-m3/ d3-m2/d2-m1/d1-m4 ramps/tracks, and cored by 4T-links: d3-m1/d2-m4/ d1-m3/d4-m2, connecting 4BF=trunks; namely a 4V4T through-interchange turnout, and in short, a kite-turnout.

[00100]FIG.15 shows a hexagram through-interchange turnout, comprising two sets of circular 3V-ramps totally inserted by d-m ramps: B1-d1-m5/B5-d5-m3/B3-d3-m1 and d2-m6-F6/d6-m4-F4/d4-m2-F2, connecting 6 BF=trunks with equating traffic flows.

[00101]When 4/6 trains synchronously approaching the kite/hexagram turn-out, each breaking into 2-3 parts, the 4F/6F parts strait forward, apical grafting 4R'/6R' parts at or before the post-kite/hexagram stations; 4M/6M parts stop

at central or second cross; 4R/6R parts switch to the right-side sub-stations; after changing passengers 4MR/6MR parts merge at the post- kite/hexagram stations, waiting for the next 4F/6F parts.

[00102]As shown by FIG.1, a multi-way station is a station (YT) or a group of sub-stations (4Yv) covering a circular-turnout; including a station covering a polybasic turnout (Yv/T2v), or a polybasic hub (T8/T16).

[00103]Shown by FIG.11-12,FIG.15-16, the large scale polygonal IC/RER turnouts can be each covered by a group of 3-16 sub-stations spreading all around; and in this way, improving their service layover and efficiency.

[00104]In a class of this embodiment, as shown by P or p in FIG.2-3, FIG.5, FIG. 13-14 and FIG.27-28, a multi-way station comprises at least one multi-lateral platform, which further comprises at least three boarding sides, for at least one rail-type; and which is monolayer or split-leveled (FIG.27-p1/p3/p5/ p7) or connected by split-level passages(FIG.14/P1-4).

[00105]As shown by hollow arrows in FIG.2-3 and FIG.5, the multi-way station or sub-stations with its/their multi-lateral platform/platforms facilitate passengers' circular-transfer, when at least three trains stop by synchronously, in a manner of heads-by-ends; and facilitate passengers' one-step transfer between parallel coaches heads-by-ends.

[00106]In FIG.1, 8 (parts of) trains synchronously stop by 4Yv sub-stations in a heads-by-ends manner, performing 4-lateral circular-transit in 4Yv-P (FIG.3).

Meanwhile, light-rail 4 trains stop by the third sides of Yv-P, in heads-by-ends manners with 8 Metro trains, performing 3-lateral circular-transfer in four independent polybasic turnouts/stations (Yv).

[00107]When a YT turnout/station frozen in the Y3V model as FIG.5, 3 trains stop by the 3-lateral P in a heads-by-ends manner; passengers getting on and off gather in central P and mid-coaches closer to central stares; passengers turning left move to head-coaches and by one-step transit to end-coaches at left side; in this way, passengers from B1-F3/B3-F2/B2-F1 trains transfer to B3-F2/B2-F1/B1-F3 trains synchronously, in good order of circulation.

[00108]The circulating-lines/networks comprise semi-return circulating- lines and non-return circulating-networks. FIG.9 shows a 4YT tree line, when its six peripheral terminals E1/E2/S and W1/W2/N all connected by two additional YT turnouts at E2/W2 into an outer ring, there appear one anti- clockwise A-ring, hooping four clockwise inner-rings C1/C2/ C3/C4; in this way the circulating line is modified into an A/4C circulating network.

[00109]FIG.1 shows, when their peripheral terminals totally connected by YT turnouts at T1-16, the 4V (T2-14-10-6-2) hollow-star line, the 8YT (T15/13/11/9/7/5/3/1) circle-radial line, and two crossing BF lines (T4-12/T8-16) totally merge into one A/C2-5 circulating-network.

[00110]In a class of this embodiment, the circulating line is a tree-line (FIG.4, FIG.8-9), or a circle-radial line (FIG.1-8YT), or a hollow-star line (FIG.1-4V,

FIG.2- 4VX/4V+/8V), or a polygonal line (FIG.11-12,FIG.14-16), comprising at least one circular-turnout, connecting at least three BF=sections, at least part of vehicles semi-return from and circulate among at least three terminals.

[00111]In a compound BF tree-line as Nanjing Line1, trains fully return between N=S and N=W by jumping shifts but never mix. While in a YT tree-line, half trains return only half way to YT, then forward to the third terminals, when YT frozen in Y3V model, all trains semi-return and circulate among E/S/W(FIG.8).

[00112]The existing suspended monorail or cable-car line is a single ring pressed plat from both sides or pulled flat by two terminals; vehicles' circulation between two points is normally recognized as BF2U. FIG.17 upper-layer shows a Y3V3U circulating line, with its single ring pressed flat from triple sides; all vehicles semi-return at, and circulate among (at least) three terminals.

[00113]In a class of this embodiment, a non-return circulating network comprises at least one inner-rings combination (FIG.1 centre). The inner-rings- combination is duplicable in two (FIG.23) or four (FIG.25) or six (FIG.16-17) ways, comprising at least two inner-rings of same rotation (FIG.9 A/4C), or at least one self-cross- loop (FIG.25 C'), or at least one self-cross-loop plus at least one inner-ring of same rotation(FIG.23 C'1/C2). The self-cross- loop comprises at least three open-end-rings of same rotation(FIG.18 C'1 or C'2, FIG.25 C'-1/2/3/4).

[00114]The existing circle line adopts an A/C or C/A routing, comprising only

one inner-ring C or A, in full BF with its outer-ring A or C. While shown by FIG.9, the circulating network A/4C comprises 4C as an inner-rings-combination, each inner-ring C1-C4 in 1/4 BF section along the same outer-ring A, and the rest in BF sections with each other.

[00115]FIG. 22 shows a butterfly-shaped inner-rings combination, comprising only one self-cross-loop, but including four open-end rings C'-1/-2/-3/-4, of same rotation; and which is duplicable in four ways.

[00116]FIG.19 shows an orange-peels inner-rings-combination, with only one self-cross-loop, which comprises six open-end rings C'-1/2/3/4/5/6 of same rotation. FIG.18 shows two self-cross-loops C'1/C'2, each in a triple-leaf shape, and comprising three open-end rings of same rotation.

[00117] In a class of this embodiment, the circulating line/network is a feeder-line or feeder-net of a miner rail-type, covering or braiding or inserting or threading at least one major rail-type, resulting in poly-rails turnouts(FIG.3) or poly-rails hub/hubs (FIG.27-28) and poly-rails sections. The feeder-net is an inner-ring (FIG.12-c1)or inner-rings-combination(FIG.1 centre) or a polygonal inner-rings-combination(FIG.16 c1/c4/c5); which comprises at least two rings of same rotation and connected by alternate angles, the inside ring is replace-able by an inner-rings-combination.

[00118]In a class of embodiment 0090, the poly-rails hub comprises at least two rail-types and at least one set of circular V-ramps of at least one rail-type; including a candlestick-hub(FIG.1-T8/16 magnified by FIG.10), or a star-hub (FIG.19/FIG.28) or a kite-hub(FIG.27), or a 个/大/木-hub(FIG.17).

[00119]According to Graph Theory, a **n**-way node in connected graph possesses vertex **n**. In case of mass transit, a **n**-way station handles **n(n-1)** trips, passing through or transit, except departure and arrival; i.e. 6 trips by a 3-way station, 12 trips by a 4-way station, 20 trips by a 5-way hub station, 30 trips by a 6-way hub station and 56 trips by an 8-way hub station…

[00120]In FIG.19 centre, double layers of Y3V frame a 6-way Star-hub. When a Metro **Y3T** turnout covered by a Monorail **y3t** line in same bearings, appears a poly-rail Star-hub; handling 30 trips (2.5 times than Cross-hub's 12), including 12 express (3 times than Cross-hub's 4) in the same two-layer space.

[00121]FIG.28 shows, when a Cross-hub of Metro or RER or both together bladed by a Monorail 4vX Hollow-star turnout/line, structured is a poly-rails 8-way Star-hub; handling 8 trips express, 4 trips circular transfer at bf1/3/5/7 and 8 trips b-BF-f follow-way feeding… totally 56 trips; nearly 5 times than the original Cross-hub and still in the same two layer space.

[00122] Shown by FIG.25-4v+M and magnified as FIG.27, when four Cross-hubs and lines of Metro overlapping or overlapped by four Monorail 4v+ turnouts and inner- rings-combinations, there come four poly-rail Kite-hubs and more b/BF/f follow-way feeding sections in same tunnels, horizontally bf turn up and vertically bf down. In this way, Metro trains only stop at Cross-hubs, being fed by Monorail trains, stopping every local stations.

[00123] Shown by FIG.16-Ge/Da/Mu and magnified as FIG.17, when rapid rails' 个/大/木 sub-stations threaded by c1/c4/c5, they are modified into poly-rails hubs. FIG.17-BF8/Bf2/BF4/bF6 form a poly-rails 4-way 个-hub, BF8/Bf2/bF6 make a Yv set and the v-ramp over-crossing BF4=8 fulfills third side circulation; it handles 5 express trips among total 12. BF8/ Bf1/Bf2/bF6/bF7 form a poly- rails 5-way 大-hub, with a same Yv set; handling 7 express trips among total 20.

The whole FIG.17 appears a poly-rails 6-way 木-hub, handling 9 express among total 30 trips.

[00124] Both 大/木-hubs comprise a light-rail's K-link, which is cored by d6-m2 ramp in horns-shape. When c4/c5 trains synchronously approaching the hub, each breaks into two parts; 2F parts non-stop and keep in their home rings till the post-K stops; 2R parts switch into the K-link, after changing passengers, cross-interchange to the post-K stops, waiting for the next shift 2F.

[00125]In FIG.1-center shaft, the **BF** line of IC railway is covered by Metro A/C2-5 network, deriving two candle-stick hubs(FIG.1-T8/T16 magnified by FIG.10), facilitating b-BF-f feeding in T8/T16 hubs and central station as well. It's better for IC trains to break into F/M/R parts, too, to same time and length of platforms. Comparatively, B-BF-F or B-B/F-F transfer is quite popular in NY or HK Metro, but those are between two lines of same rail-type.

[00126]In FIG.1 or FIG.12 square center, the 4Yv or 4Xv turnout is inserted by an 3c inner-rings-combination or a c1 inner-ring. In FIG.16, the 4Ge/4Da compound 4VX turnout and the 4Mu kite-turnout are totally inserted by a polygonal inner- rings-combination c1/c4/c5. Obviously, both c1 above can be further modified into **nc** inner-rings-combination to improve service layover.

[00127] Shown by half dots along c1/c4/c5 in FIG.16, the light trains stop one-side, in Bf=bF anti-way feeding the heavy trains (IC or RER or both together) stopping at hubs only. After c1 replaced by FIG.1-3c, framed is a 5c inner-rings-combination, facilitating trains' interchange and passengers' on-board transfer among c1-5.

[00128] A sustainable railway network of a second embodiment of the invention, comprising circular-turnouts and/or plate-turnouts, covered by multi-way stations, as cores and/or key nodes of circulating lines/networks and of feeder-lines/nets derived; employs circulating route-system to minimize red-lights,

enhance and balance traffic flows; facilitates vehicles' interchange and reorganization and passengers' on-board and/or easy transfer.

[00129] In a class of this embodiment, the plate-turnout is cored by at least one circular-plate, including a double-track plate (FIG.21) or a triple-track plate (FIG.20), facilitating bidirectional or tri-directional vehicles to pass through or switch by synchronously.

[00130] A monorail's Y3V turnout (FIG.19 upper-layer) can be modified into a plate-turnout by installing a triple-track plate. When tri-directional trains passing by synchronously, they break into 3F/3R parts and drop 3R inside the plate; 3F apical graft last shift 3R at post-Y stops; 3R switch 120°A by the plate, then forward to left side post-Y stops, waiting for next 3F parts. In this way, the Y3V line is improved same as a Y3T line, facilitating coaches' interchange and passengers' on-board transfer.

[00131] By installing one circular-plate, the double-layer 6-way star-hub (FIG.19) can be modified into a monolayer plate-turnout; inside which, 3R from B1/5/3 switch 60°A (3Z), forwarding to F4/2/6 and post-star stops, waiting for next 3F from B2/4/6; alternate angles 60°A rotation facilitate six-way coaches' circular-passing and switching repeatedly. Therefore the plate-turnout saves land and space as well, even if adopted by normal rails.

[00132] In a class of this embodiment, the circulating line/network employs at least one plate-frozen model; during which period, the both ends plate-off double-track section is modified into a double-shuttles line, the at least three ends plate-off section is modified into an at least triple-shuttles line, without interfering rest of the traffics in the network.

[00133] FIG.21 show a double-track plate at a monolayer cross, facilitating alternative 2V-turn of 90°C to nearer-side (2VN) or 90°A to further- side (2VF),

and a plate-frozen model on horizontal BF, while vertical BF=section modified into a double-shuttle line (FIG.24-2S).

[00134] As shown by FIG.24-3S and FIG.26-4S, when 3-4 ends plate-off , the 3V-4V section is modified into a triple-shuttle 3S or quadruple-shuttle 4S line; without interfering rest of the traffics. Moreover, the 3S or 4S turnout remains a circular-turnout and facilitates passengers' circular-transit, when 3/4 trains synchronically stop by the 3/4-lateral platform heads-by-ends, but all keeping right or left in alternation.

[00135] In a class of this embodiment, as shown by FIG.22, the circular-plate is a suspended plate in a pot-cover shape, fixed by double track-slots(TS) or triple track-slots underneath the plate, facilitating bidirectional or tri-directional suspended vehicles to pass through or switch by synchronously. The suspended plates, as cores and/or key nodes, enable the suspended monorail to branch or network sustainably; utilizing the reverse side of bridges or tunnels (FIG.26) to save space and building cost of both rail-types.

[00136] Both double-track or triple-track plates facilitate continuous U-turns (FIG.20-3U) at the terminals, replacing U-rings (FIG.19-U) to save land. Moreover, the plate terminal may further branch by the same plate coring a new circular-plate-turnout, in the sustainable line/network.

Claims:

1. A sustainable circulating railway line/network, comprising circular-turnouts, covered by multi-way stations, as cores and/or key nodes of circulating-line and/or network; employs circulating route-system to minimize red-lights, enhance and balance traffic flows, deriving poly-rails feeder-ship to improve service layover; facilitates vehicles' interchange and reorganizing during their operation, and passengers' on-board and/or easy transfer; improves service layover, efficiency and safety; and effectively reduces the building and operating cost of the railway network.

2. The sustainable circulating railway network of claim 1, wherein
said circular-turnout is an at least three-way turnout for bidirectional double-tracks, comprising at least three multi-connected Back-and-Forth ports, and at least one set of at least three-way V-ramps/tracks; said V-ramps/tracks turn from the Back-tracks of each BF port into the Forth-tracks of the nearer-side BF port, completing a circulation.

3. The sustainable circulating railway network of claim 1 or 2, wherein
said multi-way station is a station or a group of sub-stations covering a circular-turnout, including a station or sub-station covering a bibasic turnout or hub; said bibasic hub comprises at least two rail-types, and at least one set of at least three way V/v-ramps of at least one rail-type.

4. The sustainable circulating railway network of claim 1, wherein

said circulating lines/networks comprise semi-return circulating lines and non-return circulating networks; said circulating line/lines may branch or merge sustainably by said circular-turnouts into said circulating network, said circulating line comprises at least one circular-turnout, connecting at least three BF sections, at least part of vehicles semi-return and circulate among at least three terminals; said circulating network comprises at least one inner-rings-combination; said inner- rings-combination is duplicable in two or four or six directions, comprising at least two inner-rings of same rotation, or at least one self-cross-loop, or at least one self- cross-loop plus at least one inner-ring of same rotation; said self-cross-loop comprises at least three open-end inner-rings of same rotation.

5. The sustainable circulating railway network of claim 2, wherein
Said circular-turnout includes bibasic turnout, comprising at least three multi-connected BF or Bf or bF or bf ports, and at least three-way V/v-ramps of two rail-types in circulation; said V-ramp may be compound of parallel ramps in a crescent shape, assembling a Crescent Junction; said V-turn track comprises a serial of two Crescent Junctions; said Crescent Junction is one-way-through, comprising an Overtaking Ramp by its shorter and less-curved side, Platform Tracks by its longer and more-curved side, and a Train-Yard in between.

6. The sustainable circulating railway network of claim 2, wherein
said circular-turnout includes a switchable turnout or circular-switchable turnout; said switchable turnout comprises at least one d-m ramp; said

circular-switchable turnout comprises at least one set of at least three way V-ramps/tracks totally inserted by said d-m ramps/tracks; said d-m ramp/track is one-way, starting from a diverge-switch at the B-track of one BF port, and ends by a merge-switch at the F- track of another BF port, both diverge and merge switches irreversible with forking angles outpointing.

7. The sustainable circulating railway network of claim 2, wherein
said circular-turnout includes a plate-turnout; said plate-turnout comprises at least one turn-plate, and employs at least one plate-frozen model; said turn-plate is a ground plate or a suspended plate in pot-cover shape; said turn-plate is a double- track plate or triple-track plate, with all tracks on face or track-slots underneath longer than a single coach; during fixed plate-frozen model, the at least two ends plate-off section or at least three way sections is/are modified into at least double-shuttles line, without interfering rest of the traffic inside the network.

8. The sustainable circulating railway network of claim 10, wherein
said multi-way station comprises at least one multi-lateral platform; said multi-lateral platform is monolayer or split-leveled or connected by split-level passages, com- prising at least three boarding sides for at least one rail-type;
said multi-lateral platform or platforms in a group of sub-stations facilitates passengers' door-to-door circular- transit, when at least three trains stop by in a heads-by-ends manner.

9. The sustainable circulating railway network of claim 11, wherein
said circulating line/network includes feeder-line and feeder-net; said feeder-line covers or braids at least one major rail-type, resulting in a bibasic hub; said feeder-net is an inner-ring or inner-rings-combination, inserting or threading the major rail-type, resulting in bibasic turnouts or hubs and bibasic sections; said bibasic hub comprises at least one set of V/v-ramps of at least one rail-type; said bibasic section comprises at least two rail-types and at least double tracks parallel and bidirectional.

10. The sustainable circulating railway network of claim 6, wherein
said d-m ramp/track is restricted within the turnout range, and owing to its ship lock structure, employs four ways of switching: d/m both-on, d-on/m-off, d-off/m-on, d/m both-off; said switchable or circular-switchable turnout employs at least one switch-frozen model, during which period a d/m both-off ramp/track is modified as a parking lot or shuttle line, without interfering rest of the traffics.

SUSTAINABLE CIRCULAR TRACK LINE NETWORK

DESCRIPTON

[0001] The invention relates to the railway route-system and the line/network planning, and more particularly to the structure of multi-track turnouts and junctions, and the switch-assemblage involved therein.

[0002] Present railway networks can be classified into two --- connected or disconnected, resulting in two effects of traveling --- express and transit. The transit passengers have to walk, i.e. “transit on foot”.

[0003] A connected railway is the foundation of vehicles’ operation. However, the Metro lines adopt Back-and-Forth routing, namely BF (Back-and-Forth) lines, disconnecting each other. Even traditional two or four branched fork-lines remain compound BF routing, thereby causing traffic flow in branches cut by half, and therefore failing in continuous branching. Although connected by complex junction yards, the traditional railway is bond to too many switches and crosses, i.e. red-lights to dispatch continuous trains in BF-trips, local and express; and therefore, fails in sparse train-shifts.

[0004] Moreover, their stations or hubs with only parallel or overhead crossing tracks occupy space and layover narrowly, relying mainly on general traffics for feeder-ship. Stations become larger, higher and deeper, when bus/taxi stations and car parking gather all around, resorting crowds, causing complicated inter- change inside and disorder or even jams outside.

[0005] In summary, based on the traditional full-return route-system, lines can hardly connect each other by existing turnouts or junctions while keeping traffic flow saturate and balanced, let alone reorganizing multi-way trains; rail-transit in general can hardly expand its service layover to replace general traffics.

[0006] In view of the above described problems, it is one objective of the invention to break through the full-return routing in disconnected or stiffly connected networks; and instead, to employ circulating route-system in the properly connected and sustainable expending lines/networks; and in this way to minimize red-lights, enhance and balance multi-way traffic flows, and to facilitate vehicles' interchange instead of passengers'.

[0007] The circulating route-system helps poly-rails feeder-ship by covering or inserting or blading each other, deriving feeder-lines/nets, bibasic turnouts/ hubs and sections; facilitating more light-rails' turning instead of rapid rails'; and in this way, improving the service layover, safety and efficiency of the rail-transit in general.

[0008] To achieve the above objective, provided is fundamentally a sustainable circulating railway network, which comprises circular-turnouts covered by multi-way stations, as cores and/or key nodes of circulating lines/networks and of feeder-lines/nets derived; which breaks through the full-return BF routing and employs the circulating route-system to minimize red-lights, enhance and balance multi-way traffic flow; which facilitates the vehicles' interchange and reorganization, and the passengers' on-board and/or easy transfer; and which improves the service layover, safety and efficiency in general, and reduces the building and operating cost of the railway network.

[0009] The circular-turnout comprises at least three multi-connected Back-and-Forth ports, and at least one set of at least three-way circular V-ramps or tracks, facilitating at least tri-directional vehicles turning from the Back-track of each BF port into the Forth-track of the same(right or left) side nearby BF port, completing a circulation.

[0010] The multi-way station is a station or a group of sub-stations covering the circular-turnout, including a station or substation covering the bibasic circular-turnout or bibasic hub. The bibasic hub comprises at least two rail- types and at least tri-

directional circular-V/v-ramps of at least one rail-type.

[0011] The circulating line/network includes semi-return circulating line and non-return circulating network. The circulating line/lines can be modified or merged into the circulating network when its/their peripheral terminals connected by the circular-turnouts into an outer circle. The circulating line comprises at least one of the circular-turnout connecting at least three double- track sections, and at least part of vehicles semi-return and circulating among at least three terminals. The circulating network comprises at least one inner-rings- combination; the inner-rings-combination is duplicable in two or four or six ways, comprising at least two inner-rings of same rotation, or at least one self- cross-loop, or at least one self-cross-loop plus at least one inner-ring of same rotation; the self-cross-loop comprises at least three open-end rings of same rotation.

[0012] The circular V-ramp including those in bibasic circular-turnout made of two rail-types in circulation comprises one way compound ramps, structuring a Crescent Junction (VCJ) or a serial of two VCJs. The VCJ is one way through, with all ramps inside parallel and non-crossing each other, diverging at the entrance and merging at the exit irreversible; assembled by: Platform Tracks (PT) by its longer and more curved side, an Overtaking Track (OT) by its shorter and less curved side, and a Train Yard (TY) in between.

[0013] The circular-turnouts include the switchable turnouts and the circular switchable turnouts. The switchable turnout, including bibasic switchable turnout, comprises at least one d-m ramp; the circular-switchable turnout comprises at least one set of at least tri-directional circular V-ramps/tracks totally inserted by d-m ramps or D-M tracks. The d-m ramp or D-M track is one way, starting from a diverge-switch at the Back-track of a BF port and ending by a merge-switch at the Forth-track of another BF port, both switch-angles out- pointing and irreversible.

[0014] The circular-turnouts include plate-turnouts; the plate-turnout comprises at

least one turn-plate and employs at least one plate-frozen model. The turn-plate is a ground plate or suspended plate, a bidirectional double-track plate or tri-directional triple-track plate, with its surface tracks or underneath track-slots longer than a single coach. When certain plate-turnouts perform plate-frozen model in the circulating network, the at least both ends plate-off section modifies into an at least double-shuttles line, without interfering the rest of traffic inside the network.

[0015] The multi-way station comprise the multi-lateral platform; the multi-lateral platform is monolayer or split-leveled or connected by split-leveled passages, comprising at least three boarding sides. When at least tri-directional trains of at least one rail-type stop by in a heads-by-ends manner, passengers may enjoy door-to-door circular-transfer.

[0016] The circulating line/network includes the feeder-line or feeder-net for poly-rails feeder-ship. The feeder-line covers or blades with the major rail-type, deriving the bibasic hub; the feeder-net is an inner-ring or inner-rings-combination inserting in the major rail-type, deriving the bibasic turnouts or hubs and bibasic sections. The bibasic hub comprises two rail-types and one set of at least tri-directional V/v-ramps of at least one rail-type. The bibasic section comprises parallel two rail-types and at least bidirectional double tracks.

[0017] The circular-turnout is restricted within the turnout range in a ship- lock structure, employing four ways of switching: diverge/merge both-on, d-on/m-off, d-off/m-on, diverge/merge both-off; the switchable-turnout employs at least one switch-frozen model, during which period a diverge/merge both-off ramp/track is modified as a parking lot or a shuttle line, without interfering rest of the traffics inside the circular-turnout.

BENEFICIAL EFFECT OF THE INVENTION

[0018] 1) Circular-turnouts as cores and/or key nodes sustainably connect double

track sections into networks, causing circulate routing to minimize red lights, enhance and balance traffic flows, facilitate vehicles interchange and optimize the general dispatching and scheduling; upgrading express rate and general efficiency of people/vehicles/roads.

[0019] 2) Since circulating line/network extends and expands sustainably and poly-rails feeder-ship improves service layover and facilitate passengers' easy transfer; they effectively replace general traffic to save energy and reduce its pollution.

[0020] 3) By simplifying turnouts, junctions and stations, keeping existing double track sections and avoiding repeat constructions, the sustainable circulating line/network optimizes dispatch, safety and efficiency, reducing the building and operating cost in general.

[0021] FIG. 1 is a schematic view of the circulating lines/networks, positions of turnouts and hubs, structure of their modification and polybasic feeder-ship;

[0022] FIG. 2 shows the structure of 4V+ hollow-cross, 4VX hollow-cross and 8V hollow-star turnouts, and their door to door circular-transfer;

[0023] FIG. 3 magnifies FIG. 1-Yv/T2v turnouts and Bf = bF section in between;

[0024] FIG. 4 shows an I-shaped 4V turnout, or T-foot connected 2YT turnouts, and their switch-frozen models;

[0025] FIG. 5 shows the circular-transfer by a three lateral platform in a YT station when switch-frozen at Y3V model, and structure of three VCJs;

[0026] FIG. 6 shows structure of a T/TZ-turnout, inside which the d-m ramp across T-shoulders and the return track Z at T-foot;

[0027] FIG. 7 shows vehicles' interchange and re-organizing, and passengers' transfer in the T-turnout/station;

[0028] FIG. 8 shows vehicles' interchange and re-organizing in the Y3T turnout/station;

[0029] FIG. 9 shows a 4YT tree-line and its further modification into an A/4C circulating–network;

[0030] FIG. 10 magnifies FIG. 1-T8/T16, showing the structure of the bibasic Candlestick-hub;

[0031] FIG. 11 shows the 3YX/6YX triangle or hexagonal cross-interchange turnout;

[0032] FIG. 12 shows the 4YX/8YX square or octagonal cross-interchange turnout, structure of c1 feeder-net and 4YXv turnouts/stations;

[0033] FIG. 13 magnifies FIG. 12-Xv, showing the structure of the YXv turnout/station;

[0034] FIG. 14 shows the 4T and 4VCJ structure and 4P multi-lateral platforms, in a kite-hub and covering station;

[0035] FIG. 15 shows the structure of a hexagonal through-interchange hub;

[0036] FIG. 16 shows the position of 个/大/木-hubs, and three inner-rings c1/4/5 threading a compound 4V hub and a kite-hub, and their modification into a polygonal inner-rings combination;

[0037] FIG. 17 magnifies FIG. 16-Mu, showing the structure of the 个 or 大 or 木 -hub;

[0038] FIG. 18 is the sketch map of a Cable-Cars' circulating-network;

[0039] FIG. 19 is the sketch map of a Monorail's circulating-network;

[0040] FIG. 20 shows vehicles' interchange and re-organizing in a triple- track plate-turnout;

[0041] FIG. 21 shows vehicles' interchange and re-organizing in a double- track plate-turnout;

[0042] FIG. 22 shows the suspended circular-plate in a pot-cover shape, carrying bidirectional suspended vehicles;

[0043] FIG. 23 shows a 2c inner-rings-combination duplicable in two directions;

[0044] FIG. 24 modifies some turnouts of FIG. 23 into the plate-turnouts;

[0045] FIG. 25 shows positions of the 4v+M (2BF+) polybasic kite-hubs, and monorail's inner-rings-combination duplicable in four directions;

[0046] FIG. 26 modifies some turnouts of FIG. 25 into the plate-turnouts;

[0047] FIG. 27 FIG. shows the structure of monorail's 4V+ braiding rapid-rail's cross inside the poly-rails kite-hub;

[0048] FIG. 28 shows the structure of monorail's 4VX braiding rapid-rail's cross inside the eight-way poly-rails star-hub.

[0049] Metro or RER lines can hardly pass through a square city; while FIG. 1-T14-10/T10-T6/T6-T2/T2-T14 shows four flat-bottom V-tracks circular-turning among four BF ports at 4Yv, each from the Back-track into the right side Forth track, taking advantage of four side streets to avoid central district, and forming a four-terminal

line cored by a hollow-X turnout 4Yv. In this way, all trains on line circulate among T14-T10-T6-T2 and four double-track sections.

[0050] Shrinking above 4V-tracks into curved bottom 4V-ramps, as show by FIG. 2-BF1/3/5/7, appears a 4VX or 4V+ (BF2/4/6/8) hollow star turnout. From the central point of view, 4V-ramps turn among 4BF ports, each from B to the same side F, completing 4BF circulation; and therefore, they are both called 4V hollow-star circular-turnouts.

[0051] Accordingly, 3-nV-turn ramps or tracks without crossing each other assemble a hollow Y or star 3-n way circular-turnout; as shown by FIG. 2, the single layer 8V circular-turnout connects 8BF radiating sections into one line, fitting light-rail transit around large canters or stadiums.

[0052] Rail-transit includes narrow or monorails, all classified as light-rails. The straddle-type monorail adopts double-head trains to switch return, namely BF2Z between two terminals; whereas cored by 3-nV turnouts, formed 3-nVnZ line, all trains circulate among at least three terminals.

[0053] The suspended monorail and cable-car lines turn and clime easily, but fail to switch; adopting U-turn at both terminals, in fact, a BF2U flat single ring. Whereas FIG. 19-upper layer shows a hollow-Y shaped single ring, resulting in an Y3V3U circulating line cored by an Y3V circular-turnout; obviously all trains on line circulate among three terminals balanced and free of red lights.

[0054] Shown by FIG. 1-Yv/T2v and magnified as FIG. 3, the flat 4V-bottoms of Metro line are one-way tracks forming square; light-rail's feeding saves land and 135° obtuse angle and straight track for rapid rail. So rapid/light rail complement each other, resulting in 4Yv and 8T2v poly-rails turnouts and Bf = bF sections (= means parallel and bi-directional).

[0055] FIG. 3-T2v shows rapid rail's V-turn track is straight; FIG. 17-V2v shows cable-car's V-ramp even turning left. So the strict definition of V-ramp/track is not the angle but into the next port on same (right or left) side. That's the way to avoid red lights, for multi-way trains' turning synchronously, without crossing or interfering each other.

[0056] Shrinking just 2V-bottoms horizontally of the 4VX turnout in FIG. 1-4Yv, structured is an I-shaped four-way turnout, or 2Y connected, as shown by FIG. 4; 2Y same as Y3V in FIG. 19. Magnified Y3V in FIG. 5 shows, adding compound Vramps makes a crescent shape, namely one-way V-turn Crescent Junction (VCJ). Inside a VCJ, all ramps non-crossing each other, diverge by the entrance side and merge by the exit side irreversibly; including an Over-taking Track (OT) on the shorter and less-curved side, Platform Tracks (PT) on the longer and more-curved side, and a maintenance Train-Yard (TY) in between. In this way, 3PTs close to each other for easy transfer, while 3OTs keep away for safety.

[0057] FIG. 14 shows 4VCJs around the 4V+ kite-turnout. In FIG. 11 and FIG. 16, all the flat bottom V-tracks comprise serials of 2VCJ. In this way, tri-directional trains may pass through or reorganize inside their own VCJ without interfering each other. When managing at least two VCJs concentrated in one multi-way station, dispatching is optimized, equipment and labor saved.

[0058] FIG. 4-2T shows, by installing a d4-m1 or d2-m3 two ramp inside the Y3V turnouts, left-turning is achieved. As magnified by FIG. 6, the d3-m1 ramp is oneway, diverging from B3 and merging at F1, crossing T- shoulders and skipping off T-foot BF port, and always restricted inside the turnout range. So the horns' shape in FIG. 7 is called a T-link. In FIG. 17-K-link, d6-m2 ramp is in horn's shape, while d6- m1/d7-m2 ramps in Z-shape; but always keep fork-angles out-pointing. We define such diverge –merge (d-m, small letter represents a small circulation) or Diverge –Merge (D-M, capital letter represents a big circulation) ramp/track inside a circular-turnout as a d-m ramp or D-M track. The switchable turnout comprises at least one d-m ramp.

[0059] FIG. 6 shows, by installing a Z-track at T-foot BF2 port, modified is a TZ turnout, deriving two more d3-m2/d2-m1 ramps. The only switch unmarked d or m is under Z-track, since it's m when trains entre Z but then d when trains exit Z. Therefore, even if switches structure the same shape, they are still excluded if any switch ever plays diverge/merge both. Because all d-m ramps keep one-way irreversible, they make sure all turning and switching safe and efficient.

[0060] The switchable turnout employs at least one switch-frozen model. In FIG. 4, besides d4-m1/d2-m3 alternate T-link switching, keeping them off may restore 2Y, and keeping d4-m3/d2-m1 off may modify them into a double-shuttle (2S) line. The switch-frozen results in green-light fixed; so the 2Y or 2BF/2S model may offer denser shifts or longer trains during the rush-hours.

[0061] Owing to its ship-lock structure, the diverge-merge (d-m) ramp or Diverge-Merge (D-M) track employs four ways of switching: "diverge/merge both-on, diverge-on/merge-off, diverge-off/merge-on, and diverge/merge both-off". In FIG. 4, d4-m1or d2-m3 is restricted in one YT turnout, d4-m3 and d2-m1 still restricted inside the I-shaped turnout; so they are still modified as parking lots (FIG. 8-3R) or shuttle lines (FIG. 4-2S) when diverge/merge both-off.

[0062] In FIG. 3, although T2v employs two rail-types, T-link switching is still possible between 2v ramps of light-rail, assembling a poly-rails switchable turnout.

[0063] FIG. 7 shows, a trunk train from d3 split into F and R parts, the F part across T- shoulders non-stop to post T station, apical grafting the branch return BR' part, reorganizing a full length train; the R and BR parts circular-stop by T-shoulders, after passengers' transfer, the R part to Branch terminal, the BR part to post T station waiting for the next F part.

[0064] FIG. 9-4YT shows the continues branching by T-links, from N-S as 4T-

shoulders continues trunks; so that all trains' length cut by half in four branches from T to E1/E2/W1/W2 terminals, but enjoy same shifts as in the trunk. Normally passengers in branches much less than in the trunk, branch platforms cut by half as well, to save land and cost.

[0065] If passengers similar in branches and the trunk, adding as a return track as in FIG. 6-Z, namely T-foot return TZ turnout. F part same as FIG. 7 but R part apical grafting Z' part to branch; BR full trains split into BR/Z as well, BR part same as FIG. 7, Z part stop and return in/from Z-track, waiting for next trunk R.

[0066] In FIG. 4, only 2T-foot connected section is modifiable too long for 2S double shuttles line. If 2S section too long for shuttles, the modification of TZ-foot connected 2TZ turnouts is necessary.

[0067] As shown by FIG. 8 and FIG. 10-upper layer, T-link switching d3-m1 is duplicable by twisting 120° left and right, resulting in tripled T-link switching d3-m1/d1-m2/d2-m3, and deriving d1-m3, d3-m2 and d2-m1 three d-m ramps inserting totally Y3V ramps in circulation; connecting three BF=trunks with equating traffic flows. Besides the outside Y3V-ramps turning right in circulation, the 3T-ramps circular-turn left and cross each other, forming inside reverse circulation.

[0068] As shown by FIG. 8, when three trains synchronously approach the Y3T turnout/station, each breaking into two parts, the F1/F2/F3 parts turn nearer sides non-stop, apical grafting the last-shift R'2/R'3/R'1 parts at three post-Y3T stations towards W/E/S terminals; the 3R parts turn left into d3-m1, d1-m2 and d2-m3 ramps, after changing passengers, forward to three post-Y3T stops, waiting for next-shift 3F parts. In this way, tri-directional trains are reorganized by circular-exchanging 3R parts. And by alternate switching 3d-on/3m-off before 3R stop and 3d-off/3m-on afterwards, red-lights minimized. Moreover, a Y3T turnout connects total three trunks with equating traffic flows, facilitating total six trips express or transit-on-board among three terminals.

[0069] The above cross-interchange turnout comprises Y3V circular-switching to the nearer sides in addition with Y3T cross-switching to the further sides; upgrading one-way switching to circular-switching, so called a circular-switchable turnout. Obviously, the circular-switching requires all V-turn ramps diverge-able and merge-able; and this condition can be met by inserting d-m ramps or D-M tracks into all V-turn ramps or tracks; such as d1-m3, d3-m2 and d2-m1 in the Y3T turnout. Therefore, Y3T is classified as an YT switchable-turnout, and among which the only circular-switchable turnout as well.

[0070] Comparatively, present fork-lines cored by "从" shaped turnouts, similar to Y but lacking the third side V-ramp, and inside two tracks crossing each other, as shown by FIG. 11-YX, namely YX turnouts. YX-foot connecting BF trunk, YX-arms connecting to BF branches, causing A=B and A=C compound full-return routing in a one-trunk two-branch line. After 2YX connecting one trunk and four branches, it's hard to branch sustainably.

[0071] Although the YX turnout may facilitate front and rear separating and restoring as in Spain and Japan, but never reorganization, nor sustainable.

[0072] Whereas a YT turnout connects at least 2BF trunks; the T-link in horn's shape involve only one track, leaving the other track free of switch, or even free of rail-type as shown by FIG. 3-T2v. By A=B=C semi-return circulating, the BF line may branch sustainably, while keeping equating traffic flow (such as 2m/shift).

[0073] Connecting nYT turnouts derives n+2 terminals, as the tree line in FIG. 9-4YT. Taking N=S as a continuous trunk cored by 4T or 4TZ turnouts, at least half trains circulate among 6 terminals; when turnouts replaced by 4(Y3T) or switch-frozen as 4(Y3V), all trains circulate among 6 terminals and totally trunks.

[0074] Traffic density=coach-number X shifts; when coach-number limited by

platform length, shift-gaps become the key factor. Taking Nanjing Metro Line1 for example, N=YX=W and N=YX=E (= means parallel and bi-directional, N, YX, W, and E represent stations) four trips express at rate of 4/6; but W=E trips transit up and down. When train-shifts in N=YX trunk saturate (2m/shift), W=YX and E=YX branches share shifts (4m/shift); if further branch by YX, shift will be shared again as to 8m/shift. Supposing of equal time-distance between any two stops, then in 11 stops between N=YX occupy 11/30, 15 stops between E=YX occupy 15/30, 4 stops between W=YX occupy 4/30; 11/30+1/2 (15/30+4/30) =20.5/30; the saturation rate of the whole line traffic is about 68%.

[0075] The key of modify Nanjing Metro line 1 lays on the YX turnout, with three choices. Firstly, replacing YX by a T turnout and taking N=T=E as a continuous trunk across T-shoulders and T=W at T-foot as a branch; keep N=E return trips, N-W and W-E single trips express at the rate of 4/6; since train-length cut by half in T=W section, then 11/30+15/30+1/2x4/30=28/30, so the whole line saturation raised up to 93%. Secondly, If half-trains in T=W not enough, we can still modify T into TZ turnout with 100% saturation. Thirdly, installing a Y3T turnout to connect Y=N, Y=E and Y=W as totally trunks, with traffic 100% saturated, and 6 trips among three terminals N/E/W totally express.

[0076] Moreover, the YT turnouts facilitate continuous branching with traffic flows enhanced and balanced, by keeping at least one trunk sustainable. In case of Nanjing Metro Line 1, further branching in Y=E or Y=W extended section (similar to FIG. 6-4YT) become possible. Under the condition of saturate traffic, Line 1 is modified sustainably into a 3-n terminal circulating line, with service layover improved obviously.

[0077] When tri-directional intercity or regional railway BF lines gathering in a city, the Y3T turnout can be magnified, with V-turn ramps prolonged into tracks, forming a triangle cross-turnout as per fig11-3YX; D1-M5, D5-M3 and D3-M1 circular-switchable in three ways. The triangle cross-turnout is also visible as 3YX turnouts

hugging together.

[0078] As analyzed before, present YX or 2YX line is an compound BF line. When 3YX gather together, 6BF branches connected and 6 terminals vanish, but three BF trunks remain and out-pointing. In this way, original DIVERGE/MERGE switch modified into D-M tracks; trains semi-return from and circulate among only 3 terminals. Covering 3YX turnout, a group of 3-6 sub-stations can be set, to let tri-directional trains each splitting into 2-4 parts, to cross-interchange and re- organize synchronously.

[0079] When six intercity or regional BF lines gathering in a large city, double layers of 3YX turnouts can be set as FIG. 11, adding 6 d-m ramps to connect two layers in a ring; 6-directional trains each split into three parts, to cross-interchange and re-organize synchronously. Covering the 6+ (cross) 6YX turnout in large scale, 12 stations can be set, avoiding central town and improving service layout.

[0080] Accordingly, FIG. 12-BF1/3/5/7 frames a 4YX square cross-turnout; inside which, D1-M7, D7-M5, D5-M3 and D3-M1 circular-switch in four ways. Double layers of 4YX in alternate angles, and connected appears an octagon as FIG. 12- BF1-8, 2(4YX) connected by eight additional d-m ramps; synchronous eight trains each split into four parts to cross interchange and reorganize; namely an octagonal cross-turnout.

[0081] In above polygonal cross-turnouts, “nD on” or “nM on” alternate switching same as in Y3T turnout. Switching in double layer polygonal cross-turnouts, follows the nD-nd-(nd-nm)-nm-nM order in circulation, same time at different points, or same points in different time; even if 1-2’ per switch, 6-8 trains take 6-16’ to cross-interchange and reorganize into 6-8 new trains synchronously.

[0082] Shown by FIG. 13, a kite-shaped turnout comprises one set of 4V-ramps or tracks totally inserted by d1-m4/d4-m3/ d3-m2/d2-m1 ramps/tracks, and cored by 4T-

links: d2-m4/ d3-m1/d4-m2/d1-m3, connecting 4BF=trunks; namely a 4V4T through-interchange turnout, and in short, a kite-turnout.

[0083] FIG. 14 shows a hexagram through-interchange turnout, comprising two sets of circular 3V-ramps totally inserted by d-m ramps: B1-d1-m5/B5-d5-m3/B3-d3-m1 and d2-m6-F6/d6-m4-F4/d4-m2-F2, connecting 3BF = trunks in two layers (not three) with equating traffic flows.

[0084] In summary of above large scale circular-turnouts for Intercity, they each comprise at least three circular V-turn ramps/tracks, totally inserted by d-m ramps or D-M tracks, connecting at least three BF=trunks with equating traffic flows; and therefore classified as polygonal interchange turnouts.

[0085] In urban group region or continent, sustainably connecting intercity or RER BF=sections by circular-turnouts as cores and/or key-nodes, will certainly result in circulating lines/networks. Provided all stations between similar time-distance, all trains in orderly circulation may depart or arrive synchronously. Passengers between any two stations may just choose their directions, and then move ahead or backward on board, to arrive expressively.

[0086] According to Graph Theory, a n-way node in connected graph possesses vertex n. In case of mass transit, a n-way station handles n(n-1) trips, passing through or transit, except departure and arrival; i.e. 6 trips by a 3-way station, 12 trips by a 4-way station, 20 trips by a 5-way hub station, 30 trips by a 6-way hub station and 56 trips by an 8-way hub station.

[0087] In reference of the feeder-line in sea freight, we define the transits between at least two rail-types as poly-rails feeder-ship, and the lighter or miner rail-type as the feeder. The existing light-rail feeding Metro or Metro feeding intercity is simply double or triple layers' crossing.

[0088] Shown by FIG. 18-centre, double layers of Y3T or y3t/Y3T assemble a snow-flake or poly-rails six-way hub; handling 30 trips (2.5 times than Crosshub's 12), including 12 express (3 times than Cross-hub's 4) in the same two layers space. In same two storied space, the hub may dispatch 30 trips (2.5 times of a cross-hub), among which 12 trips express (3 times of a cross-hub).

[0089] Present uni-platform transit of New York/Hong Kong Metro between lines of same rail-type, can be expressed as B-BF-F or B-B/F-F. Whereas the poly-rails feeder-ship facilitates b-BF-f transit as shown by FIG. 1- center shaft.

[0090] Shown by FIG. 1-T8/T16 and magnified by FIG. 10, when the intercity BF line covered and fed by Metro's YT station, framed is a Candle-stick hub, facilitating b-BF-f transit between two rail-types.

[0091] FIG. 2-4V+/4VX turnouts are monolayer and central hollow; fitting well the rapid rails' cross, by threading or braiding; making transit easier, and saving space and cost as well.

[0092] Shown by FIG. 27, when a Metro's cross-hub fed and overlapped by Monrail's 4v+ turnout, there comes a poly-rail Kite-hub; in the same tunnels, horizontally bf turn up and vertically bf down, stopping upper p2/6, and under p4/8, except multi-lateral P1/3/5/7.

[0093] FIG. 28 shows, when a Cross-hub of Metro or RER or both together fed and bladed by a Monorail 4vX Hollow-star turnout/line, structured is a poly-rails 8-way Star-hub; handling 8 trips express, 4 trips circular transfer at bf1/3/5/7, and 8 trips b-BF-f follow-way feeding totally 56 trips; nearly 5 times than the original Cross-hub and still in the same two-layer space.

[0094] Shown by FIG. 16-Ge/Da/Mu and magnified as FIG. 17, when rapid rails'个/大/木 sub-stations threaded by c1/c4/c5, they are modified into poly-rails hubs. FIG.17-

BF8/bF6/BF4/Bf2 form a poly-rails 4-way 个-hub, BF8/Bf2/bF6 make a Yv set and the v-ramp over-crossing BF4=8 fulfills third side circulation; it handles 5 express trips among total 12.

[0095] BF8/bF7/bF6/Bf2/ Bf1 form a poly- rails 5-way 大-hub, with a same Yv set; handling 7 express trips among total 20. The whole FIG. 17 appears a poly-rails 6-way 木-hub, handling 9 express among total 30 trips.

[0096] Shown by FIG. 1-square circle and magnified by FIG. 3, the double-track sections between 4Yv and 8(T2v) comprise rapid/light rails, therefore named as asymmetric Bf=bF sections, with asymmetric rail-types including volumes, shifts and stops. Suppose the rapid-rail trains 2'/shift, stopping in hubs only; while light-rail trains 1'/shift, stopping at all stations (FIG. 15-half dots).

[0097] The poly-rails in feeder-ship normally all keep right as in USA, or all left as in UK. But on Euro-Asia continent, most intercity keep left while urban rails keep right. FIG. 12 shows, when light-rail c1 inserting intercity 4YX turnout (BF1/3/5/7), framed are 4YXv poly-rails turnouts and four FBf = bFB asymmetric sections. In reference FIG. 1-centre, c1 is still replace-able by 3c-combination.

[0098] Adopting the circular-turnout(s) a core or key nodes, connecting at least three BF=sections, structured is a semi-return circulating line; including a hollow star line as in FIG. 1-2, a tree line in FIG. 4/9, a polygonal line cored by FIG. 11-16, and a 8YT circle radial line as in FIG. 1-T1/T3/T5/T7/T9/T11/T13.

[0099] Present circle line is made by two rings Clockwise and Anti-clockwise, namely an A/C line. The existing Metro networks normally comprise 1-3A/C+nBF lines, crossing each other but disconnected.

[0100] Whereas the circulating network replaces the inner ring by an inner rings-combination, namely A/nC or C/nA; all vehicles circulate in every section besides the

outer-ring no return.

[0101] FIG. 9 shows, when terminals E2/W2 modified into YT stations, and further connect their left/right terminals into an outer circle; same rotation C1-4 ring by ring, covered by outer ring A, the tree-line modified into an A/4C circles-combination, with all non-return vehicles circulating inside.

[0102] FIG. 18 shows the Cable-Car's A/2C' circulating network; inside which C'1 and C'2 each in a triple-leaf shape, and comprises three open-end rings of same rotation, so called as self-cross-loop. Comparatively, 8-shaped loop has two open-end rings with opposite rotation; and it's therefore except.

[0103] FIG. 19 shows an orange-peels inner-rings-combination, with only one self-cross-loop, comprising six open-end rings C'-1/2/3/4/5/6 of same rotation. FIG.25 shows a butterfly-shaped self-cross-loop, but including four open-end rings C'-1/2/3/4, of same rotation; it forms an inner-rings-combination alone, and is duplicable in four ways.

[0104] FIG. 23 shows an inner-rings-combination, made of one self-cross-loop C'1 plus one inner-ring C2 of same rotation. The inner-rings-combination of light- rail in FIG. 1-centre, is assembled by one self-cross-loop c'1, plus two rings c2/c3 of same rotation; namely 3c-combination.

[0105] FIG. 1 shows, on the base of Cross 2BF lines, 4V hollow-X line and 8YT circle- radial line, totally connecting T1-16 terminals by YT turnouts, then all four lines merge into one A/C2-5 circulating-network; inside which C'3-5 as self-cross-loops, plus C2 as an inner-ring of same rotation, and C1 replaced by 3c inner-rings-combination; then all trains circulate among all sections and stations, offering more express trips.

[0106] Knowing above T1-16 modification, we may preset them as T2Z transitional

terminals, same as T-links. Mono-head trains turn over the right T-shoulder, backward over the left T-shoulder, and forward again to T-foot. Although T2Z in same shape of FIG. 7, but d3-m1 is not a d-m ramp before modified into a YT station.

[0107] A circulating network comprises as least one inner-rings-combination, which is duplicable in two (FIG. 23) or four (FIG. 25) or six (FIG. 18-19) directions, inside the same outer ring; a feeder-net may omit the outer ring (FIG. 1-3c/FIG. 12-c1).

[0108] The limit of Metro shift-gap is about 2' for BF lines, but 72" for non- return A/C lines (experience from Japan). Accordingly, the circulating-network may increase train-shifts and transport capacity by 80%.

[0109] The suspended monorail and cable-car can is limited by switching. With the help of circulating network and plate-turnout, their networks and service can be brought into full play, while their equipments saved. FIG. 15-c1/c4/c5 shows light-rail inner-rings inserting rapid-rails turnouts, framing three non-return circulating feeder networks; when connected by K-links merging into one polygonal inner-rings combination, i.e. a 3c feeder-net. The light-rail threads or braids "个/大/木" hubs as well in this case.

[0110] When light-rail 3c feeder net inserting FIG. 1-A/4C rapid-rails' network, service layover of downtown improved obviously. If FIG. 15-c1 replaced by FIG. 1-3c, assembled is 5c inner-rings-combination, made of c'1/c2-5 circulating feeder-net.

[0111] FIG. 20 shows, the tri-directional plate may circular-switch in 3 or 6 way turnout as FIG. 19, by dispatching tri-directional trains synchronously passing through, each leaving the last coach inside the plate for switching. The plate may turn 120° or 60° for 3 or 6 way turnout, to turn left or straight forward.

[0112] FIG. 21 shows a bidirectional plate for a cross-turnout, bidirectional trains synchronously passing through, each leaving the last coach inside the plate for

switching. The plate not only offer easy switching, but also save space.

[0113] FIG. 22 shows a suspended plate in pot-cover's shape, carrying BF trains to pass through or circular-switch alternately. Obviously each track on a ground plate, or track-slot under the suspended plate, is longer than a single coach and coincide the surrounding track or track-slot.

[0114] When part of turnouts in FIG. 23 and FIG. 25 modified into plate-turnouts as in FIG. 24 and FIG. 26, traffic among warp and weft rails is achieved. During the rush-hours, a plate-frozen model may enhance the straight traffic; whereas the 2 ends plate- off section is modified into a double-shuttles (2s) line, the 3 or 4 ends plate-off section is modified into a 3s or 4s line. Provided the 3-4 BF sections of same time distance, 3-4 trains depart, meet and stop at same time; circular-transfer is still available during alternate shuttles keeping right or left.

[0115] Installing circular-plates for terminals' U-turn may save equipments and space, and lay foundation for future plate-turnout as well.

CLAIMS

1. A sustainable circulating railway line/network, comprising circular-turnouts, covered by multi-way stations, as cores and/or key nodes of circulating-line/network including poly-rails feeder-line/net derived; wherein the circulating railway line/network employs a circulating route-system to minimize red-lights, enhance and balance traffic flow, facilitates vehicles' interchange and reorganizing, and passengers' on-board and/or easy transfer, improves service layover, safety and efficiency in general, and effectively reduces the building and operating cost of the railway network.

2. The sustainable circulating railway line/network of claim 1, characterized in that the circular-turnout is an at least three-way turnout for bidirectional double- tracks, comprising at least three multi-connected Back-and-Forth ports, and at least one set of at least three-way circular V-ramps/tracks; the circular V-ramp/ track turn from the Back-track of each BF port into the Forth-track of the same side nearby BF port, completing a circulation.

3. The sustainable circulating railway line/network of claim 1 or 2, characterized in that the multi-way station comprises a station or a group of sub-stations covering a circulating- turnout, the multi-way station is a group of sub-stations covering an interchange hub, or a station covering a polybasic interchange hub, and a multi-lateral platform is monolayer or split-leveled or connected by split-level

passages, comprising at least three boarding sides for trains of at least one rail-type.

4. The sustainable circulating railway line/network of claim 1 or 2, characterized in that the circulating line/network is a feeder-line or feeder-net of a miner rail-type; the feeder-line or feeder-net covers or braids or inserts or threads at least one major rail-type, resulting in poly-rails hub/hubs or poly-rails turnouts and poly-rails sections; the feeder-net is an inner-ring or inner-rings-combination or a polygonal inner-rings-combination; the polygonal inner-rings-combination comprises at least two inner-rings of same rotation and connected in alternate angles, the inside ring is replace-able by an inner-rings-combination; the poly-rails hub comprises at least two rail-types, and one set of circular V/v- ramps of at least one rail-type.

5. The sustainable circulating railway line/network of claim 2, characterized in that the V-ramp comprises parallel ramps in a crescent shape, assembling a Crescent Junction; the V-track comprises a serial of two Crescent Junctions; the Crescent Junction is one-way-through, comprising an Overtaking Track by its shorter and less-curved side, Platform-Tracks by its longer and more-curved side, and a Train- Yard in between.

6. The sustainable circulating railway line/network of claim 2, characterized in that the d-m ramp or D-M track is in a ship-lock structure and employs four ways of switching: diverge/merge both-on, d-on/m-off, d-off/m-on, diverge/merge both-off; the switchable- turnout or circular-switchable turnout employs at least one switch-frozen model, during which period a diverge/merge both-off ramp/track is modified as a parking lot or a shuttle line, without interfering rest of the

traffic in the circular-turnout; the circular turnout is a hollow-star turnout, comprising at least one set of at least four-way circular V-ramps/tracks in circulation, connecting at least four BF ports and double-track sections.

7. The sustainable circulating railway line/network of claim 2, characterized in that the plate-turnout comprises at least one circular-plate; the circular-plate is a double-track plate or a triple-track plate, facilitating bidirectional or tri- directional vehicles to pass through or circular-switch; the circular-plate is a suspended plate of a pot-cover shape, comprising double or triple track-slots fixed underneath the plate, facilitating bidirectional or tri-directional suspended vehicles to pass through or circular-switch; the circulating line/network employs at least one plate-frozen model, during which period, the both ends plate-off double-track section is modified into a double-shuttles line; the at least three ends plate-off double-track sections are modified into an at least triple-shuttles line.

8. The sustainable circulating railway line/network of claim 3, characterized in that the multi-way station comprises at least one multi-lateral platform, which further comprises at least three boarding sides for at least one rail-type, and which is mono- layer or split-leveled or connected by split-leveled passages, and the multi-lateral platform facilitates passengers' circular-interchange, when at least three trains synchronously approach and stop by in a manner of head-by-end.

9. The sustainable circulating railway line/network of claim 4, characterized in that the circulating line/network is a feeder-line or feeder-net of a miner rail-type; the feeder-line or feeder-net covers or braids or inserts or threads at least one major rail-type, resulting in

poly-rails hub/hubs or poly-rails turnouts and poly-rails sections; the feeder-net is an inner-ring or inner-rings-combination or a polygonal inner-rings-combination; the polygonal inner-rings-combination comprises at least two inner-rings of same rotation and connected in alternate angles, the inside ring is replace-able by an inner-rings-combination; the multi-way station is a station or a group of sub-stations covering the circular-turnout, including a station or sub-station covering a poly-rails turnout or poly-rails hub.

10. The sustainable circulating railway line/network of claim 6, characterized in that the circular turnout is a switchable turnout or a circular-switchable turnout; the switchable turnout comprises at least one d-m ramp; the circular-switchable turnout comprises at least one set of at least three way circular V-ramps/tracks totally inserted by d-m ramps or D-M tracks; the d-m ramp or D-M track is one-way, starting from a diverge-switch and ending by a merge-switch, both diverge/merge-switches irreversible and restricted within the circular-turnout range.