

DESCRIPTION OF THE INVENTION

MULTI LEVEL AUTOMATED CAR PARKING SYSTEM

5 **Background of the Invention:**

1. Prelude

Whereas multi level automatic car parking has become a basic infrastructure in the current economic development, the over dimensional platform carriers, that too in large numbers, posed a challenge for handling and storage. There is a time gap between
10 handling two successive vehicles. When a number of vehicles report simultaneously for parking as it happens during peak hours, the pressure on the system is so much as to cause a virtual breakdown. Vehicles reporting for parking have to wait in queue causing irritation to clients besides creating traffic congestion. Similarly, when the requests for
15 retrievals pour in heavily at the closing hours, the system becomes unmanageable and goes haywire. So far no workable solution has emerged with the result that the growth of the multi level automatic parking facilities is hindered.

2. Prior Arts:

20

Description:

The prior art by the U.S. Patent 5, 024, 571 dated 18.06.1991 stipulates one elevator for every entry and exit. The prior art thus deploys quite a good number of elevators to answer the simultaneous requests for parking and delivery. This has limitations and
25 further adversely affects costs and space saving. The prior arts are conspicuous by their silence on storage and handling arrangements of platform carriers. There are separate exit and entry points in the prior arts, and the transfer of platform carriers from exit to entry point is cumbersome. Some vague attempts have been tried by providing a multi-tier storage inside the elevator. In short, handling of over-dimensional platform carriers in
30 large numbers and the peak-hour pressure on the system remain unaddressed.

The prior art by our own application 216/CHE/04 effectively solves the drawbacks and disadvantages of earlier prior arts in the areas of simplicity, space saving and

compactness. Hence the system was limited to two wheelers of limited capacity where platform carriers are of manageable dimensions and weights and queuing two wheelers are of no serious consequence to traffic because of their size.

5 **3. Invention**

This invention, therefore, is to overcome the drawbacks and disadvantages of the prior art systems and to offer multi level, automated car parking system in which the cars are stored into and retrieved from addressed slots automatically in simple, practical, safe, speedy, reliable, user-friendly and cost-effective manner, in which cars to be parked are
10 simultaneously stored, in which retrieved cars are placed for simultaneous delivery and in which the platform carriers are automatically put into use when required and stack piled when not in use.

4. Objective

15 The main object of the present invention is to provide a system in which cars are stored into and retrieved from addressed slots automatically in simple, practical, safe, speedy, reliable, user-friendly and cost-effective manner.

It is another object of the present invention to deploy more number of relatively less
20 expensive transfer module for simultaneous operations on all parking floors for the optimum utilization of the highly expensive elevator and to ensure quick parking and retrieval.

It is another object of the present invention to provide a system for storage and handling
25 of the over-dimensional platform carriers automatically in safe, efficient, reliable, fast and cost effective manner to answer the present demands of 'fit-and-forget' trend.

It is another object of the present invention to open more entry/exit points to allow
simultaneous placement of cars for parking/delivery without waiting.

30

It is another object of the present invention to relocate the entry and exit points with ease to meet the peak hour demands besides meeting normal demands.

It is another object of the present invention to receive cars reporting for parking and to park the cars without pressure and to process a plurality of retrieval requests and to place a plurality of retrieved cars to enable the clients to collect their vehicles without undue wait.

5

It is another object of the present invention to allow acceptance of cars for parking, parking, retrieval and delivery of retrieved cars, all simultaneously without operational hindrance to each other.

10 5. Salient Features:

The present invention –

- a) substantially saves on the requirement of prohibitively expensive land space.
- b) Imparts forward and reverse movement of the platform carrier by simple push-pull means in place of the cumbersome dog drive and endless chain arrangement and does away with a plurality of tracks on parking slots and consequent alignment complications.
- c) Introduces power arm and transfer module both having independent direct drives with reversible option and their integration into a single embodiment as a concept to simplify the transfer of cars for parking and retrieval into and out of parking slots.
- d) Introduces the power arm as an independent unit with reversible option drive in the elevator to draw the platform carrier with the car into and out of elevator.
- e) facilitates simultaneous placement of a plurality of cars for parking/delivery at the same time.
- f) provides two independent slat conveyors with reversible option drive in front of elevators in ground floor and basement each to offer the facility as in (e) above.
- g) introduces a concept of platform carriers by assembling a number of plates with hinged joints between them so that they are adaptable to mechanical handling.
- h) modifies the basic layout by providing four row of vertical storage space for platform carriers between the elevators in both basement and ground floor.

i) Introduces a mechanical handling system to serve each slat conveyor to place platform carriers over slat conveyors when required and to stack pile the platform carriers when not in use.

5 j) introduces a guide-rail system throughout the length of the slat conveyors except the transit point in front of the elevators and loading point on the conveyors to keep the platform carriers in position while in transit and to absorb thrusts while driving cars onto or out of the slat conveyors.

6. Description of the Invention:

10 According to this invention, RCC /steel structures are erected to provide tiers for parking. The basement is reserved for delivery of cars and the ground floor is dedicated for receiving cars for parking. A plurality of tiers is provided for parking of parked cars. Each tier has a plurality of parking slots on either side with fixed tracks running along the entire length. Each tier has one or more transfer modules moving along the above fixed
15 track. Each transfer module has a power arm with independent reversible option drive and moves along a fixed track on the transfer module. The whole complex is well illuminated and ventilated as per building codes.

At least two elevators are provided along the axis of the line of parking with sufficient space between them for storing platform carriers. Each elevator has one power arm with
20 a reversible option drive to move along a fixed track inside the elevator.

Two slat conveyors are provided in front of elevators on ground level and in the basement where vehicles enter for parking/exit after retrieval. These conveyors are in line and are parallel to the line of parking. Reversible option motors drive these conveyors. The two numbers are for redundancy and for improving the efficient of the system. The
25 slat conveyors on their top have fixed walkways with space between two adjacent walkways. The space between the two adjacent walkways is provided to accommodate one platform carrier. The conventional concept of single piece platform carriers is changed and a new design of a platform carrier with a number of plates hinged together is introduced. This design permits better management of storage of platform carriers and
30 mechanization of their handling. The sliding brackets are provided on both ends of the

plates forming platform carriers. Guide rails run along the entire track-length of the conveyors except in front of elevators and at the point of the slat conveyor. The sliding brackets and guide rails maintain the platform carriers in position during transit besides absorbing thrusts during driving in/away of cars. The conveyors are supported throughout to prevent sagging of chain by weight and by the hinged plates construction.

Four independent mechanical handling systems (one each serving one slat conveyor) comprising monorail, hoisting equipment and designed lifting tackles are provided.

7. Description of the system

- 10 The invention will be better understood from the description of the embodiments with reference to accompanying drawings, as follows.

Figure 1 is the general view of the parking facility.

Figure 2 is the plan view of the basement where retrieved cars are delivered.

- 15 Figure 3 is the plan view of the ground floor where cars are received for parking.

Figure 4 is the plan view of a typical parking floor.

Figure 5 is the schematic elevation of the facility with slat conveyors and stacked platform carriers in position.

Figure 6 is the view AA showing the drive end of the slat conveyor.

- 20 Figure 7 is the view BB showing a portion of the slat conveyor.

Figure 8 is the view CC showing the non-drive end of the slat conveyor.

Figure 9 is the plan and elevation of a platform carrier.

Figure 10 is the schematic plan and elevation of the transfer module and a power arm.

Figure 11 is the schematic plan and elevation of the elevator with the power arm.

- 25 Figure 12 is the isometric view of the handling system for platform carriers.

Figure 13 is the floor chart for parking.

Figure 14 is the floor chart for retrieval.

- 30 The following are the component identification that are used to refer to the embodiments of the system:

1. Multi level automatic car parking facility

2. Basement
3. Ground Floor
4. Parking floor
5. Entry points
- 5 6. Exit points
7. Parking slots
8. Transfer module track
9. Slat conveyor
10. Walkways
- 10 11. Space for platform carrier
12. Drum pulley
13. Drive Motor
14. Bearings
15. Support rollers
- 15 16. Guide rails for platform carriers
17. Transfer module means
18. Transfer module drive
19. Power arm track
20. Power arm means on the transfer module
- 20 21. Power arm drive.
22. Power arm magnetic security means.
23. Power arm lifting means
24. Elevator
25. Power arm track in the elevator
- 25 26. Elevator power arm means
27. Power arms
28. Power arm support mounting brackets
29. Power arm magnetic security means
30. Platform carrier
- 30 31. Sliding brackets

- 32. Platform carrier power arm receptacles
- 33. Platform carrier matching engagement means
- 34. Platform carrier storage area
- 35. Mono rail
- 5 36. Hoisting equipment
- 37. Lifting tackle
- 38. System controller

10 The system will now be described fully with the help of the figures accompanying the invention:

A general view of the parking facility (Part 1, Fig.1) is shown. The basement (Part 2, Fig.2) of the parking facility is dedicated for delivery of the retrieved vehicles. Arrows in the basement at exit points (Part 6, Fig.2) show the direction of the movement of
15 retrieved vehicles. The ground floor (Part 3, Fig.3) is similarly reserved for receiving vehicles reporting for parking. Arrows in the ground floor at entry points (Part 5, Fig.3) show the direction of the movement of vehicles reporting for parking. A typical parking floor (Part 4, Fig.4) is shown with cars in the parking slots (Part 7, Fig.4), transfer module (Part 17, Fig.4 & 10) with power arm (Part 20, Fig.4 & 10) on the transfer module
20 track (Part 8, Fig.4). Two elevators (Part 24, Fig 2,3, 4) are positioned with a gap to provide sufficient space to accommodate the return drums (Part 12, Fig.8) of the two slat conveyors (Part 9, Fig.2,3,5) in line and also provide storage space (Part 34, Fig.5, 12) for the platform carriers (Part 30, Fig.9). Each elevator has a power arm means (Part 26, Fig.11). This power arm means has an independent drive with reversible option and
25 moves along a fixed track (Part 25, Fig.11) inside the elevator.

A transfer module means (Part 17, Fig.4,10) is a structural assembly unit with independent drive (Part 21, Fig.10) with reversible option. This transfer module runs along a first track (Part 8, Fig.4) parallel to the parking slots (Part 7, Fig.4) in each
30 parking floor (Part 4, Fig.4). A second track (Part 19, Fig.10) on the transfer module guides the movement of the power arm means (Part 20, Fig.10) transversely to the

movement of the transfer module means (Part 17, Fig.4,10). This power arm has independent drive (Part 21, Fig.10).

The slat conveyors (Part 9, Fig 2,3) are driven by motors (Part 13, Fig 6) and drum pulleys (Part 12, Fig 6,8). The drum pulleys are supported by thrust bearings (Part 14, Fig 6). Walkways (Part 10, Fig.2,3) are permanently fixed on the top of the slat conveyors with space (Part 11, Fig.2,3) to accommodate platform carriers (Part 30, Fig.9) between two adjacent walkways. Guide rails (Part 16, Fig.7) run on the track along the slat conveyor to guide the movement of platform carriers (Part 30, Fig.9). Construction of platform carriers is shown in Fig.9. Support rollers (Part 15, Fig.7) are provided to prevent sagging due to weight and due to hinged construction. Safety interlocks and guards ensure highest safety to clients and cars.

Four sets of handling systems comprising monorail (Part 35, Fig.12), hoisting equipments (Part 36, Fig.12) and designed lifting tackles (Part 37, Fig.12), two in basement and two at ground level, are provided. All these embodiments of the system, viz, elevators, slat conveyors, transfer modules, power arms in the elevators and transfer modules and the handling equipments, are programmed and controlled to work in tandem with each other to ensure continuous parking and retrieval operations by the system controller (Part 38, Fig.13,14).

8. The operation of the system

The uniqueness of this invention lies in its easy adaptability to meet changing patterns in parking/retrieval demands. The operations of the system, under normal and peak hour conditions, are described below:

Normal conditions:

Parking: Normal conditions apply when vehicles reporting for parking more or less match the retrieval requests. As a car reports at the reception, the system controller acknowledges receipt of the vehicle, checks availability and allots a platform carrier and displays and directs the client to the entry point at the ground level. The client following the instructions drives the car onto the allotted platform carrier, applies hand brakes, alights, locks the car and walks away along the walkway. When one slat conveyor is full,

the system controller recognizes and directs the reporting car to the other vacant slot conveyor. Obeying command from the system controller, the power arm in the elevator, moving on the fixed third track in the elevator, draws the platform carrier with the car immediately in front of it into the elevator. The elevator raises the car to the parking floor. On reaching the floor, the power arm in the elevator, similarly moving on its track, pushes the platform carriers with the car onto the waiting transfer module. The transfer module, moving on fixed first track on the parking floor, carries the platform carrier with the car to the designated slot. On reaching the destination, the power arm in the transfer module, moving along the fixed second track in the transfer module, pushes the platform carrier with the car into the allotted slot. The slot conveyor moves forward to place the next platform carrier with the car in front of the elevator to continue the parking operations till all the remaining platform carriers with cars are cleared from the slot conveyor. Such receiving and parking operations are alternated between the two slot conveyors on the ground floor. The whole thing is represented by a Flow Sheet (Fig.13) for clarity.

Retrieval: When a request for retrieval reaches the system controller, the system controller directs the transfer module in the specific parking floor to move along the fixed first track to reach the parking slot. On reaching, the power arm moving along the fixed second track in the transfer module tows the particular platform carrier with the car onto the transfer module. The transfer module, moving on the fixed first track, carries the platform carrier with the car to the waiting elevator. The power arm in the elevator, moving on its track, draws the platform carrier with the car into the elevator and the elevator descends to the delivery floor. On reaching the delivery floor, the power arm in the elevator pushes the platform carrier with the car onto the vacant space in the slot conveyor immediately in front of the elevator. The slot conveyor moves forward to place the retrieved car to the delivery point and to simultaneously position the next vacant space in the slot conveyor to continue the retrieval operations till retrieved cars occupy all the vacant spaces in the slot conveyor. The client, taking clue from the main system display, walks up to his car and drives away. Such delivery and retrieval operations are alternated between the two slot conveyors in the basement. The whole thing is represented by a Flow Sheet (Fig.14 for clarity.

Peak Hour Conditions:

Parking: At the start of the day, the demand for parking is at its peak. To cope with the situation, the system controller presses one or both of the slat conveyors in the delivery section into parking operations till the situation normalizes. The system controller takes additional care to coordinate among the slat conveyors for proper execution. By this arrangement, the capacity to handle parking requests is doubled.

Retrieval: Likewise, at the close of the day, the demand for retrieval is at its peak. To cope with the situation, the system controller presses one or both of the slat conveyors in the receiving section into retrieval operations till the situation normalizes. The system controller takes additional care to coordinate among the slat conveyors for proper execution. By this arrangement, the capacity to handle retrieval requests is doubled.

Handling (storage): Once the system controller recognizes full occupancy of the spaces in the delivery section of any slat conveyor, the system controller commands the handling system to come into operation. The handling arrangement picks up the platform carrier immediately below its loading point, carries along the monorail and stacks alternately in two rows. The slat conveyor moves forward to bring the next platform carrier to be stored into the loading point. This operation continues till all the platform carriers in the slat conveyors are stacked.

Handling (Loading): Once the system controller recognizes full vacancy of the space in the receiving section of any slat conveyor, the system controller commands the handling system to come into operation. The handling arrangement picks up the platform carrier alternately from two storage rows, carries along the monorail and places on the slat conveyor at the loading point. The slat conveyor moves forward to bring the next vacant space into loading point for receiving next platform carrier. This operation continues till all the vacant spaces in the slat conveyor are loaded with platform carriers.

The system controller commands, controls, monitors and co-ordinates among the elevators, power arms in the elevator, transfer modules and power arms at each parking floor, slat conveyors at basement and ground level, handling systems at four locations and the display at the entrance.

WE CLAIM -

1. A multi-level, automated car parking facility, comprising:

a storage structure having one or more tiers with one or more common entry and exit points;

5 at least one permanently fixed input-cum-output elevator with speed options;

a plurality of addressed slots in a plurality of parking platforms;

a plurality of platform carriers each with wheels and adapted to carry a single car from reception to delivery and

10 a centrally operated system controller for automatic parking of a car in an addressed vacant slot and retrieval of a car from a slot independently and without hindrance to any of the parked cars;

CHARACTERISED in that,

two elevators with space between them for storage of platform carriers,

15 a transfer module having an independent drive with reversible option moving on a permanently fixed first track running perpendicular to and in front of the parking slots on each parking platform,

a power arm on each transfer module, having an independent drive with reversible option moving on a permanently fixed second track on said transfer module, the said
20 second track running transverse to the said first track on each parking platform,

a power arm in each elevator, having an independent drive with reversible option moving on a permanently fixed third track in each elevator, the said track running transversely to the axis of the slat conveyor,

slat conveyors, two at basement and two at ground level, with reversible option drive and
25 having fixed walkways with space between the adjacent walkways to receive platform carriers,

handling systems comprising mono-rail, hoisting equipment and lifting tackle to load the platform carriers on to the slat conveyors when required and to stack pile the platform carriers when not in use, and

2. a facility according to claim (1) in which each elevator will have a permanently placed power arm with independent drive with reversible option and moving along the fixed track within the elevator.

5 3. a facility according to claim (1) in which 2 Nos. independent slat conveyors with reversible option drive and with fixed walkways on the top with space between two adjacent walkways to accommodate platform carriers, are provided in the basement and at the ground level.

4. a facility according to claim (1) in which the platform carriers are assembly of a number of plates hinged together and with sliding brackets to move in guide rails to
10 maintain its position during transit.

5. a facility according to claim (1) in which handling system for each conveyor are provided to handle platform carriers in and out of use.

6. Method of parking of cars in a multi-level automated parking system comprising steps of –

- 15 a. receiving a plurality of cars on a plurality of platform carriers positioned over the slat conveyor on one wing to its full capacity,
- b. Denying entry to further cars to the wing and diverting cars platform carriers positioned over the slat conveyor on the other wing,
- c. towing the platform carrier with the car on the slat conveyor immediately in front
20 of the elevator by the power arm in the elevator into the elevator,
- d. raising the elevator to the designated floor,
- e. pushing the platform carrier with the car by the power arm in the elevator from the elevator onto the waiting transfer module at the parking floor,
- f. moving the transfer module carrying the platform carrier with the car to the
25 designated slot,
- g. moving the platform carrier with the car into the parking slot by the power arm in the transfer module, and
- h. moving the next platform carrier with the car by the slat conveyor towards the elevator to continue parking operations.

7. Method of delivery of the retrieved cars in a multi-level automated parking system comprising steps of –

- a. moving the transfer module in the parking floor to the specific parking slot,
- b. towing the platform carrier with the car from the parking slot by the power arm in the transfer module onto the transfer module,
- c. Moving the transfer module carrying the platform carrier with car towards the elevator,
- d. towing the platform carrier with the car into the elevator by the power arm in the elevator,
- e. lowering the elevator,
- f. pushing the platform carrier with the car onto the vacant space in the slot conveyor immediately in front of the elevator, by the power arm in the elevator,
- g. moving the next space on the slot conveyor towards the elevator to continue retrieval operation, and
- h. driving away of the retrieved cars by the clients.

8. Method of storing platform carriers when not in use comprising steps of –

- a. ensuring full occupancy of the spaces for platform carriers on the slot conveyor,
- b. lifting the platform carrier immediately below the loading point from the slot conveyor,
- c. moving the platform carrier on the fixed mono rail to the storage area,
- d. stacking the platform carrier alternately in the two wings of the storage area,
- e. moving the handling system to the loading point to pick up the next platform carrier, and
- f. moving the next platform carrier by the slot conveyor to the loading point to continue the piling operation.

9. Method of loading platform carriers for use comprising steps of –

- a. ensuring full vacancy of the space on the slot conveyor,
- b. lifting the platform carrier alternately from the two wings of the storage by the handling system,

- c. moving the platform carrier on the fixed mono rail to the loading point,
 - d. loading the platform carrier in the vacant space on the slat conveyor,
 - e. moving the handling system to storage area to pick up the next platform carrier,
and
 - 5 f. moving the next vacant space in the conveyor to the loading point to continue
the loading operation.
10. Method according to claim (1) in which the software is employed to command,
control, monitor and co-ordinate among the elevators, power arms in the elevators,
transfer modules, power arms in transfer modules, slat conveyors, handling systems and
10 the display at the entrance.