

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 March 2002 (07.03.2002)

PCT

(10) International Publication Number
WO 02/19046 A1

(51) International Patent Classification⁷: **G05B 19/05**,
G06F 17/60

(74) Agent: **FRIEDLAND, David, K.**; Lott & Friedland, P.A.,
P.O. Drawer 141098, Coral Gables, FL 33114-1098 (US).

(21) International Application Number: PCT/US00/24225

(22) International Filing Date: 31 August 2000 (31.08.2000)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **COSITE.COM, INC.** [US/US]; 7000 W. Palmetto Park Road, Suite 305, Boca Raton, FL 33433 (US).

(72) Inventors: **AKLEPI, Alex**; 7375 S.W. 114 Street, Miami, FL 33156 (US). **LEBEDEV, Vladimir**; 500 Three Islands Boulevard, #715, Hallandale, FL 33009 (US). **MARMOL, Johnny, R.**; 15012 S.W. 104 Street, #2404, Miami, FL 33196 (US). **NAGLI, Raphael**; 3475 Country CL Drive, #610, Aventura, FL 33180 (US). **AHMED, Naveed**; 431 W. Camino Real, #7, Boca Raton, FL 33432 (US). **CHERENKOV, Pavel, V.**; 16919 North Bay Road, #620, Sunny Isles Beach, FL 33160 (US). **MIAGKOV, Andrey, V.**; 2017 South Ocean Drive, Apt. No. 806, Hallandale, FL 33009 (US). **KOUROPTEV, Eugene, S.**; 250 174th Street, Miami, FL 33160 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

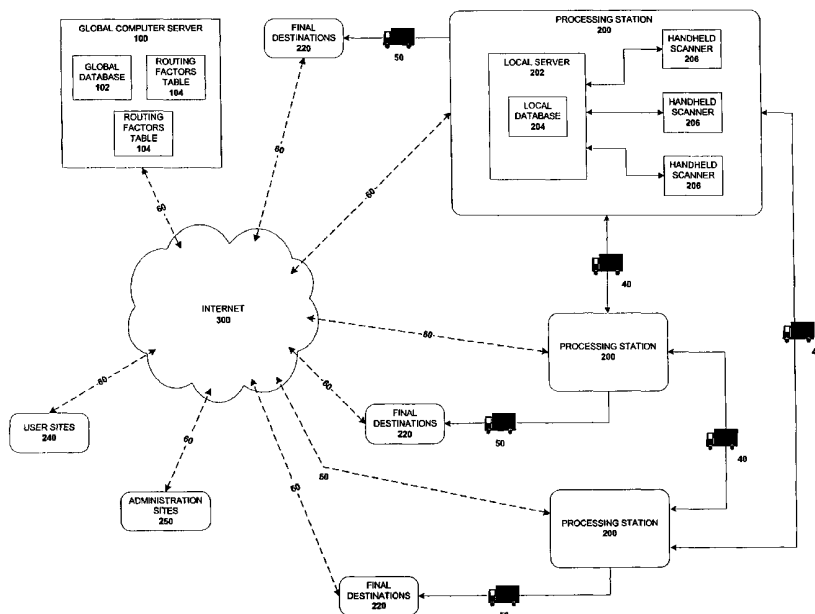
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CENTRALIZED SYSTEM AND METHOD FOR OPTIMALLY ROUTING AND TRACKING ARTICLES



(57) Abstract: A computer-implemented centralized article routing and tracking system and method for optimally routing an article through a network of processing stations. The system and method generate an optimal route based on variable factors such as weather, traffic, and available equipment and can re-calculate said route at every stop based on updated information. The system and method permits tracking of an article regardless of whether the article has been consolidated with other articles or not.



WO 02/19046 A1

5

1

10

**CENTRALIZED SYSTEM AND METHOD FOR OPTIMALLY ROUTING
AND TRACKING ARTICLES**

FIELD OF INVENTION

15

The present invention relates generally to article processing and delivery, and specifically to a computer-implemented method and system for optimally routing an article through a network of processing, delivery and routing stations, centrally tracking the location, controlling, and routing the article within the network either individually or as part of a group of articles.

20

BACKGROUND OF THE INVENTION

More so today than at any time in the past, businesses and consumers require more efficient, flexible, and economic methods for transportation and delivery of articles such as raw materials, manufactured goods, packages, parcels and parts. Today's retailers, wholesalers and manufacturers make use of advanced "supply-chain" models to maintain minimal inventories and "work in progress", make maximum use of limited warehousing and storage capabilities, and in the process reduce costs while maintaining output capabilities sufficient to meet changing demand. In order to fully realize the benefits of these modern logistics and manufacturing models, businesses require systems which minimize transit times, allow for maximum control of goods (i.e., the ability to re-route and hold articles in transit) and permit up-to-the-minute tracking of articles. In addition, in order to minimize transportation and translocation costs, it is beneficial to have the ability to

25

30

2

consolidate or de-consolidate groups of articles while in transit without losing the ability to track and route articles individually. It is also important for businesses to have accurate information regarding estimated production, delivery and pick up times for articles, to be able to adjust such times to meet production requirements and to
5 have "end to end" accountability of shipments in transit.

In a manufacturing setting, it is also necessary to maintain complete control over the tracking and routing of parts, assemblies, raw materials and other articles as they flow through a production process. Important characteristics of a routing and tracking system for use in a manufacturing situation include the ability to account for
10 and divert parts and partial assemblies to locations in the manufacturing process where they are needed the most. Additionally, such a system must be able to accurately track Work-In-Process in order to actually project production throughput and timing for finished goods. In some industries such as pharmaceuticals, medical device manufacturing and aircraft parts manufacturing, such a system may play an
15 integral role in tracking parts, assemblies or materials for regulatory related purposes. The manufacturing settings in question can be contained within a single building or be spread out geographically and any tracking a routing system used must be flexible enough to allow for either situation or a combination thereof.

In addition to their own manufacturing and supply chain needs, businesses
20 require similar routing, tracking and control features for shipments whose ultimate recipient is a customer, whether it be a consumer or another business. In order to increase customer satisfaction and gain a competitive advantage, suppliers and retailers need to be able to provide the most accurate real time or near real time information regarding the location of an article, and the ability to re-route articles on
25 an item or container basis.

From the consumer standpoint, modern retailing channels, such as mail-order catalogs, broadcast media, and the Internet, have increasingly relied on deliveries to allow purchasing of goods without the necessity of physically visiting traditional
"brick and mortar" retail locations. In order to induce more consumers to utilize
30 remote or virtual purchasing channels, it is imperative that delivery options be as

convenient as possible and that they approach the options available to buyers in physical stores. It is important for consumers to be able to determine the exact location of an order and to be able to modify shipment routings to suit their convenience. It is also desirable to minimize delivery times by optimizing article
5 delivery routes interactively and in real time based on timely updated fast-changing conditions such as traffic, available equipment, regional weather, etc.

Previous attempts have been made to provide methods for moving delivering, tracking or routing articles as described in U.S. Patent No. 6,094,642 to *Stephenson et al.* (hereinafter "the '642 patent"); U.S. Patent No. 5,043,908 to *Manduley et al.*
10 (hereinafter "the '908 patent"); U.S. Patent No. 6,047,264 to *Fisher et al.* (hereinafter "the '264 patent"); U.S. Patent No. 4,630,216 to *Tyler et al.* (hereinafter "the '216 patent"); and U.S. Patent No. 6,073,114 to *Perkins, III et al.* (hereinafter "the '114 patent"); all of which are incorporate herein by reference.

The '642 patent describes an integrated data collection and transmission
15 system and method for collecting and transmitting data related to package delivery. The system and method utilize various components that are commonly connected via one or both of an infrared communications link and a microradio link. This system is limited in that it only provides tracking capabilities and no routing, re-routing, optimization or consolidation features.

20 The '908 patent describes a system for monitoring the delivery of mail pieces passing through multiple stages in a delivery network. The system relies on the application of a unique tracking ID to each piece of mail entering the network and associating with each such piece a set route and scheduled arrival times and dates at each stop along said route. The ID and corresponding schedule is stored in a central
25 database maintained in a computer which is capable of querying local computers at each delivery stop. Upon arrival at each stop along its prescribed route, a mail piece's ID is recorded and an actual arrival time and date is entered into a local database maintained in said local computers. Periodically, the central computer queries all local stations for presence of a particular item. If an item fails to arrive at a delivery
30 stop on schedule, or is delivered to an incorrect stop, an alarm is triggered which

prompts an action within the system to locate a lost item and to expedite its delivery when, and if, it is located.

Because the system described by the '908 patent assigns a predetermined route to a mail piece upon entry into the delivery network, it can neither account for
5 changing conditions nor change the route of a shipment on that basis. In addition, this system does not permit consolidation or de-consolidation of items in transit or tracking on an item-level basis for mail pieces grouped together for delivery to a common address. Finally, this system only allows for changes to the route of a mail piece when an alarm is triggered and does not permit changes to the final destination
10 of the mail piece. Therefore this system does not provide complete control over delivery of items within it nor does it optimize the delivery route.

The '264 patent describes a method for automatically generating and transmitting e-mail messages to customers appraising them of tracking events related to their in-transit packages. The invention disclosed by the '264 patent is directed at
15 merchants who ship goods to customers via common carriers who, in turn, track packages by referring to a unique tracking identification number. This invention allows customers to automatically receive updates, via e-mail, regarding the location of packages after they have been shipped by the merchant. Because it is merely a notification system the invention described in the '264 patent does not account for
20 conditions affecting routing or delivery nor can it change, or in any way control, the route of a shipment on that, or any other, basis. In addition, the system does not permit consolidation or de-consolidation of items. Therefore this system also does not provide any control over delivery of items within it nor their delivery routes.

The '216 patent describes a computer-controlled conveying system for use in
25 transporting materials between different locations. The system includes a plurality of carriages for receiving and holding the materials and a track along which the carriages move in transporting the materials. Each of the carriages has a unique identifier, which is used by a system controller to monitor and control the movement of the carriage. A number of transfer units, and corresponding transfer unit controllers, are
30 provided along the track. The transfer unit controllers communicate with a system

controller and, in conjunction with the transfer units and information received from the system controller, act to provide the desired path for end of the carriages. This system, however, only deals with fixed routes that do not require adjustment to compensate for variable conditions. In addition, routing in this system cannot be
5 optimized and the system cannot track articles on an item-level basis but only on the basis of an entire carriage(s) load. Moreover, this system does permit tracking of consolidated shipments or de-consolidation of items from a particular carriage without losing tracking information.

The '114 patent describes a method for tracking timber and other commodities
10 from the time they are harvested through the time of delivery to its ultimate purchaser. This system makes use of discrete memory devices which are attached to the sides of trucks used to transport the timber. The memory devices may be read and written to by a computer through a field terminal device. Through a field terminal device, a forester transmits all information regarding a particular load of timber immediately
15 after it is cut and loaded on a truck. The information stored can include details about the timber (size of logs, number of logs, etc.) the name of the owner of the logs and handling instructions. At each transit step before ultimate delivery of the timber, the data from the data device is read and recorded on a local personal computer and a new record is written to the data device which may contain new information which can be
20 used to ensure that the timber is routed to the correct location, handled properly, and that no timber is diverted from a truck load. Different transit locations have different capabilities to write and extract information to/from the memory device and to generate reports from such information. This method is limited in that the computers at the different transit locations are not networked and the reports and logs generated
25 by each computer must be manually transmitted via diskettes or e-mailed in order to fully integrate all the data generated. Accordingly, the method operates more as a report-generation tool and "after the fact" control than a real-time tracking tool. Moreover, this system does not include any routing features, optimized or otherwise, as it is completely decentralized and all routing decisions are made prior to entry of an
30 item into the system. The system is not capable of automatically routing or re-routing

6

a load based on changing conditions nor does it allow consolidation and de-consolidation of items in a load or loads.

None of the inventions mentioned above describe a system for routing an article through a process delivery network which permits repeated re-optimization of a delivery route based on constantly updated conditions, complete control over the delivery date, time and location of the article, consolidation and de-consolidation of articles, and real-time or near real-time tracking of individual articles by using a centralized database which is easily accessible by all parties interested in the status of articles.

Therefore, there is a need in the art for a more flexible, powerful and efficient system and method of routing and tracking articles by calculating an optimized delivery route using timely information regarding available equipment, available warehouse or storage space, a desired delivery date, traffic delays, weather, and other variables, and re-optimizing the route based on updated conditions after each stop along the delivery network.

There is a further need in the art for a system and method for routing articles which permits consolidation of articles from multiple origination points and a common destination address, or, conversely, de-consolidation of articles from a single origination point and multiple destination addresses, while retaining the ability to track articles individually or as part of the consolidated unit.

There is a further need in the art for a system and method for tracking and re-routing articles interactively through an electronic communications network by allowing a user to search a central database for tracking information on an article, whether it is an individual item or part of a group of consolidated articles, using a single unique identification number.

There is a further need in the art for a system and method for tracking and routing articles which allows the user to identify articles while in transit or processing and manually change their routing, specify required stops, alter their final destination, and otherwise control delivery of said articles prior to arrival at their final destinations.

Finally, there is a yet a need in the art for a system and method for tracking and routing articles which automatically detects when an article has been misdirected and re-calculates an optimal routing to the correct destination without requiring the article to “backtrack” to the last correct stop.

5

SUMMARY OF THE INVENTION

The present invention solves significant problems in the art by providing a computer-implemented system and method for routing a articles through a delivery network which permits repeated re-optimization of delivery routes based on timely
10 updated conditions, complete control over the delivery dates, times and locations of the articles, consolidation and de-consolidation of articles, and real-time or near real-time tracking of individual or grouped articles by using a centralized database which is easily accessible by all parties interested in the status of the articles.

Generally described, the computer-implemented centralized system for
15 optimally routing and tracking articles comprises a global computer server accessible through an electronic communications network, the global server comprising: a global database containing a record of routing and tracking information for each article handled by the system; an optimizer for calculating, and periodically re-calculating, an optimal route for each article handled by the system and for updating the global
20 database with changes to the routing and tracking information; a database of route optimization factors accessible by the optimizer for use in the calculation and re-calculation of the optimal route; a tracker enabling users of the system to review the tracking and routing information and to modify the route optimization factor database; a plurality of processing stations arrayed throughout a delivery area for the system; at
25 each such processing station, a local computer server capable of periodically receiving from the global computer server identification, handling and routing instructions for each article to be processed at the processing station and periodically transmitting to the global computer server information regarding all handling activities performed on articles processed at the processing station; at each such processing station, one or
30 more handheld scanning devices capable of receiving from the local computer server

article identification information, handling instructions and routing information, and also being capable of collecting identification and handling activity information for each article received at each the processing station and transmitting the identification and handling activity information to the local computer server; and transportation
5 means capable of transporting articles between and among the processing stations, article origination points and article destination points.

Generally described, the computer-implemented method for delivering packages through a centrally optimized tracking and routing system of the present invention comprises the steps of, receiving a package at one of a plurality of
10 processing stations arrayed throughout a delivery area, using a first handheld scanner to collect package identification and final destination data from said package, transmitting said package identification and final destination data along with scanning time and date data to a local computer server, periodically uploading said
15 identification, time, date and final destination data, along with processing station identification data to a global computer server at a centralized location, at said global computer server, incorporating the uploaded information into a global database, calculating an optimal route along the several processing stations for said package based on its current location, final destination and several variable factors,
20 determining whether said optimal route requires the package to be transported to a next processing station or directly to its final destination, updating the record for said package in said global database with said identification information for said next processing station or final destination, downloading said package record information to the local computer server at the processing station where the package is located,
25 transmitting said downloaded package record to said handheld scanner or a second handheld scanner at said processing station, scanning said package to obtain identification information, displaying the next station or final destination identification information for said package, placing the package inside transportation means, such as a truck, and transporting the package to said next processing station or final destination, if the package is transported to a next processing station, repeating
30 the above steps until the package is delivered at its final destination, once the package

is transported to its final destination, scanning said package with said first or second handheld scanners or a third handheld scanner immediately prior to delivery and inputting into said handheld scanner delivery information for said package, transmitting said delivery information to the last processing station which processed the package, and uploading said delivery information to said global computer server.

Accordingly, it is an object of the present invention to provide a more flexible, powerful and efficient system and method of routing and tracking articles by calculating an optimized delivery route using timely information regarding available equipment, available warehouse capacity, a desired delivery date, traffic delays, weather, and other variables, and re-optimizing the route based on updated conditions after each stop along the delivery network.

It is a further object of the present invention to provide a system and method for routing articles which permits consolidation of articles from multiple origination points and a common destination address, or, conversely, de-consolidation of articles from a single origination point and multiple destination addresses, while retaining the ability to track articles individually or as part of the consolidated unit.

It is a further object of the present invention to provide a system and method for tracking and re-routing articles interactively through an electronic communications network by allowing a user to search a central database for tracking information on an article, whether it is an individual item or part of a group of consolidated articles, using a single unique identification number.

It is a further object of the present invention to provide a system and method for tracking and routing articles which allows the user to identify articles while in transit and manually change their routing, specify required stops, alter their final destination, and otherwise control delivery of said articles prior to arrival at their final destinations.

It is a further object of the present invention to provide a system and method for tracking and routing articles which automatically detects when an article has been misdirected and re-calculates an optimal routing to the correct destination without requiring the article to "backtrack" to the last correct stop.

10

These and other objects, features and advantages of the present invention may be more clearly understood and appreciated from a review of the following summary of the invention, detailed description of the disclosed embodiments and by reference to the appended drawings and claims.

5

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating major components and connections thereof of the centralized package routing and tracking system of the present invention.

10

FIG. 2 is a diagram illustrating the steps in a system implementing a preferred embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring initially to **FIG. 1** of the drawings, in which like numerals indicate like elements throughout the several views, major components and connections thereof of the centralized package routing and tracking system of the present invention include a global computer server **100** containing a global database **102** of routing and tracking information for articles handled by the system, a routing factors table **104** containing information used by the global computer server **100** to create optimized routing instructions, and an optimization rules table **106** which contains information regarding how optimization factors are applied to each article. The global computer server **100** is connected to other components in the system via a communications link **60** to an electronic communications network, such as the Internet **300**. The electronic link **60** between the global computer server **100**, as well as other components in the system, and the Internet **300** may consist of a telephone connection through a modem, a DSL line, an ATM connection, an ISDN connection, a satellite linkup, or any other standard method of network connection. In addition, although the Internet is used in the preferred embodiment of the present invention, other types communications networks can be used to implement the invention with similar results.

A plurality of processing stations **200** is arrayed throughout the geographic area covered by the system. Each processing station **200** is equipped with a local server **202** which in turn contains a local database **204** for temporary storage of routing and tracking information received from, and transmitted to, the global computer server **100**. Connected to the local server **202** at each processing station **200** are one or more handheld scanners **206** which are used to retrieve information from articles processed by the system, to retrieve routing and tracking information from the local server **202**, and to transmit tracking and routing information to the local server **202** for later transmission to the global server **100**. The connection between the handheld scanners **206** and the local server need not be permanent and may be achieved by using physical connections, such as cables or synchronization cradles, or wireless interfaces such as radio frequency (RF) or infrared (IR) transmission. The processing station **200** is connected to the global computer server **100** system via a communications link **60** to an electronic communications network, such as the Internet **300**.

Each processing station **200** is connected via one or more physical transportation route **40** to one or more processing stations **200** for transfer of articles between stations. Each processing station **200** may also be connected via one or more physical transportation route **50** to a final destination **220** for final delivery of articles.

Authorized users of the system may access, and interact with, the global database **102** by connecting to the global computer server **100** through the Internet **300** via a communications link **60** from either a user site **240**, a final destination **220** or a processing station **200**. A system administrator may access, and interact with, the global database **102** and may make revisions or updates to the routing factors table **104** based on new conditions, by connecting to the global computer server **100** through the Internet **300** via a communications link **60** from either an administrator site **240** or a processing station **200**.

A diagram depicting the steps involved in the typical application of a preferred embodiment of the present invention is shown in **FIG. 2**. The sequence begins at

12

step 1 when the article to be tracked is delivered to the initial processing station. Prior to arrival to the processing station or upon receipt at said processing station, an identification number and final destination is incorporated into the article either by the sender or by personnel at the processing station. In step 2, the identification number and final destination on the article are read and recorded using a handheld scanner and, subsequently, in step 3, the handheld scanner is synchronized with the local server at the processing station. Upon synchronization, the article's information is transferred from the handheld scanner to the local server. Similarly, during synchronization, any new information in the local server about articles in process or to be processed by the processing station is transferred to the handheld scanner. In step 4, after the handheld scanner is synchronized, the local server similarly synchronizes itself with the global computer server by transferring to the global server all new information about all articles, including the subject article, received or handled by the processing station. Upon synchronization, the global computer server looks up the record for the article using its identification number and if no record is found, as is the case with new articles, a new record is created for the article in the global database. In step 4, the global computer server also transfers to the local server any new information from the global database about packages to be processed at the subject processing station. In step 5, the optimizer software at the global computer server calculates an optimal route for the article from its present location to its final destination. This optimization is carried out using a route optimization algorithm which makes use variables from the route factors table and the routing rules table stored at the global server. The optimization rules for new articles are set in a default configuration and may be modified by authorized users of the system who wish to adjust routing of the article.

After an optimized route is calculated, the subject article's record in the global database is updated with the identifier for the next processing station along the optimal route, or, if applicable based on the optimal route, with the final destination. In step 6, the global computer server and local server are again synchronized and in step 7 a handheld scanner at the processing station is synchronized with the local

13

server. In step 8, the next time the article is scanned by a handheld scanner at the processing station, the scanner displays to the scanner operator the identifier for the next stop along the route and a "gate" within the processing station designated for a truck, or other transportation means, which is scheduled to travel to the next stop. A gate assignment designates not only a physical location within the processing station but also may include a pick up time and a particular delivery vehicle. Prior to transferring the article to its assigned gate, in step 9 the operator of the system may make an inquiry as to whether the article is to be consolidated into a container or deconsolidated from one prior to beginning the next leg of its route. If no consolidation is desired, in step 10, the article is transported to its assigned gate at the processing station. If consolidation is desired, the article is physically consolidated into a container in step 10A. Upon consolidation, the article and container are scanned by handheld scanner and the container's identifier is associated with the article record contained in the handheld scanner.. Then, in step 10B, the container is transported to its assigned gate at the processing station.

When the article or container arrives at its gate, in step 11 it is once again scanned at the gate, loaded onto the truck assigned to that gate, and the truck proceeds to the next stop along the articles route. After the article is loaded and scanned, in steps 12 and 13, the handheld scanners involved in handling of the article are synchronized with the local server and the local server is synchronized with the global computer server. At the global computer server, the record for the article in question is updated with the new handling information and, if applicable, a container number is added to the record. Proceeding to step 14, if after step 11 the article is en-route to another processing station, then upon arrival at that processing station, steps 1 to 13 are repeated until the next stop in the optimized route for the article is its final destination. If an article is en-route to its final destination after step 11, in step 15, upon arrival at the final destination, the article is scanned using a handheld scanner and delivery information is recorded in the scanner. Upon the delivery vehicle's return to the processing station, in step 16 the handheld scanner is synchronized with the local server. Finally, in step 17, the local server is synchronized with the global

computer server which incorporates all new handling and delivery information and closes the global database record for the subject article.

In the preferred embodiment of the present invention, an optimal route for each article can re-calculated every time the article is received at an intermediate processing station. The factors considered in determining the optimal route for an article, and therefore the next processing station along said route, include, without limitation, distance between processing stations, average speed between processing stations, available transportation equipment between processing stations, average load and unload time at processing stations, traffic conditions, and weather. Values for variables which represent the routing optimization factors are maintained in a separate database which is updated as conditions change and is accessible to the global computer server every time it calculates and re-calculates an optimal route for any given article in the system. Whenever an article arrives at a processing station, the optimization software conducts a check of the database of routing variables and if any changes have occurred since the most recent route optimization, a new optimal route is calculated for the article. In this fashion, the system allows for automatic route adjustments to account for fast-changing conditions which allows for much more efficient routing of articles than that allowed by a static route.

In the preferred embodiment of the present invention, the global database of routing and tracking information maintains a separate record for each article handled by the system. The format for the global database is flexible so as to allow the addition of multiple kinds of identifiers to a single article record. The most basic identifier is an article tracking number which is incorporated on the article in a computer readable format, such as a bar code, and is unique to the article. A second type of identifier, a customer identifier, can be assigned manually by the shipper or recipient of the article in order to allow for more convenient tracking and routing of multiple articles or for ease of interfacing with existing accounting systems. A customer identifier may correspond to a particular purchase order, customer number, or client account. By using a customer identifier as the search criteria for the global database, a user can easily locate, track and control multiple packages sharing a

15

common characteristic. Another type of identifier in the preferred embodiment of the present invention is a consolidation identifier, which, as its name implies, is associated with an article to denote it has been consolidated into a container. For the purposes of the present invention, a container is defined as a consolidated group of articles which has a common attribute such as its origination point, its destination point or its composition. Containers can themselves be included or "nested" within other containers or combined with other articles. When an article is consolidated with other articles into a container, the operator at the processing station will scan the article and the container and indicate that the container's identifier should be associated with the article. When this information is received by the global computer server, the container's identifier is added to the global database record for the article. Any handling activity thereafter performed on the subject article will automatically be reflected in the global database record for the subject article as well as the records for all other articles consolidated in the container. In order to allow for nested container consolidation, database article records may include more than one consolidation identifier. An article record which includes more than one consolidation identifier denotes an article which has been consolidated with other containers or articles into a container, which container has in turn been consolidated with other containers or articles into yet another container. In order to avoid duplicate record entries for tracking activity of articles in nested consolidation situations, in the preferred embodiment, activity for only the most recently entered consolidation identifier is added to the article's database record. Whenever an article is de-consolidated, the appropriate consolidation identifiers are de-associated from the article record, allowing the record to accurately show the tracking history of the article while no longer representing the articles current state. Once a consolidation identifier is de-associated from the article's database record, tracking of consolidated activity ceases for that article with regard to the container corresponding to the removed identifier.

In the preferred embodiment, all routing activities are centralized in the global computer server which, in turn, may be accessed and manipulated through an electronic communications network such as the Internet. In the preferred

embodiment, an authorized user accesses the system from a personal computer through a standard Internet browser and enters the tracking number or customer identifier for the article or articles to be tracked. The authorized user is then be presented with a page showing the present status of the articles, tracking activity for each article, and the next scheduled stop along with an estimated time and date of delivery based on the most recent optimized routing. Using the browser, the user is then be able to modify routing options for each article or for the entire group of articles. The routing options may include, without limitation, canceling shipments in transit, changing the final destination of an article or articles, changing routing optimization variables by assigning more or less weight to factors such as average speed between processing stations, weather or traffic, requesting that articles be held at particular processing stations, requesting consolidation or de-consolidation of shipments, and requesting that a particular route be used regardless of optimization considerations. Any custom routing options entered by the user are then translated into a set of routing rules for the affected global database article records. At the next stop in each article's route, the global server will query the routing rules and take them into account when re-calculating the optimal route for each article. If no custom routing option's are specified by the user, the optimized route is re-calculated using a predetermined set of default routing rules.

In a preferred embodiment of the present invention, the routing and tracking system can detect an article which has been sent to an erroneous processing station and can take corrective action by generating a new optimized route for the article from said erroneous processing station. Since the local computer server at the processing station downloads identification information from the global computer server about every article scheduled to arrive at said processing station, upon arrival an scanning of the misdirected article, the handheld scanner, which has in turn downloaded the scheduled article information from the local computer server, will alert the operator that the article has been sent to the processing station in error. The operator can then accept the information and choose to return the article to the

processing station from which it came or, alternatively, proceed to route the article normally from the present routing station to its final destination.

It will be understood by those skilled in the relevant art that while the preferred embodiment is directed towards a system for tracking and routing articles through processing stations at disparate geographic locations, alternative
5 embodiments of the present invention may be utilized to track and articles through processing stations which are located in very close proximity to each other or even in the same building.

It will also be understood by those skilled in the relevant art that while the
10 preferred embodiment refers to a computer environment which includes a single global computer server and a single local server at each processing station, alternative embodiments of the invention may include multiple global computer servers and multiple local servers at each processing station which alone or in combination perform essentially the same function as that of the global computer server and the
15 local servers of the preferred embodiment.

Accordingly, it will be understood that the preferred embodiment of the present invention has been disclosed by way of example and that other modifications and alterations may occur to those skilled in the art without departing from the scope and spirit of the appended claims.

What is claimed is:

1. A computer-implemented centralized system for optimally routing and tracking articles comprising:
 - 5 a global computer server accessible through an electronic communications network, said global server comprising: a global database containing a record of routing and tracking information for each article handled by the system; an optimizer for calculating, and periodically re-calculating, an optimal route for each article handled by said system and for updating said global database with changes to said routing and tracking information; a database of route optimization factors accessible by said optimizer for use in said calculation and re-calculation of said optimal route; a tracker enabling users of said system to review said tracking and routing information and to modify said route optimization factor database,
 - 10 a plurality of processing stations arrayed throughout a delivery area for said system,
 - at each such processing station, a local computer server capable of periodically receiving from said global computer server identification, handling and routing instructions for each article to be processed at said processing station and periodically transmitting to said global computer server information regarding all handling activities performed on articles processed at said processing station,
 - 20 at each such processing station, one or more scanning devices capable of receiving from said local computer server article identification information, handling instructions and routing information, and also being capable of collecting identification and handling activity information for each article received at each said processing station

and transmitting said identification and handling activity information to said local computer server, and
transportation means capable of transporting articles between and among said processing stations, article origination points and article destination points.

5

2. A computer-implemented method for delivering an article using a centrally optimized tracking and routing system, the method comprising the steps of:

10

at a first processing station, using a first scanner to collect article identification data and final destination data from said article,
transmitting from said first scanner to a local computer server at said first processing station, said article identification data and final destination data along with scanning time and date data,

15

transmitting from said first processing station to a global computer server said article identification, time, date and final destination data, along with identification data for said first processing station,

20

at said global computer server, incorporating said data transmitted from said first processing station into an article record at a global article information database,
calculating an optimal route for transporting said article from said first processing stations to said final destination and updating said article record with identification information for the first stop along said optimal route,

25

transmitting from said global computer server to said local computer server said updated package record information,
transmitting said package record information to said first scanner or a second scanner at said processing station,
scanning said package with said first or second scanner and displaying said first stop identification information for said package,

20

transporting said package from said first processing station to said first stop,

if said first stop is not also said final destination, repeating the above steps at said next stop until said package is delivered at said final destination.

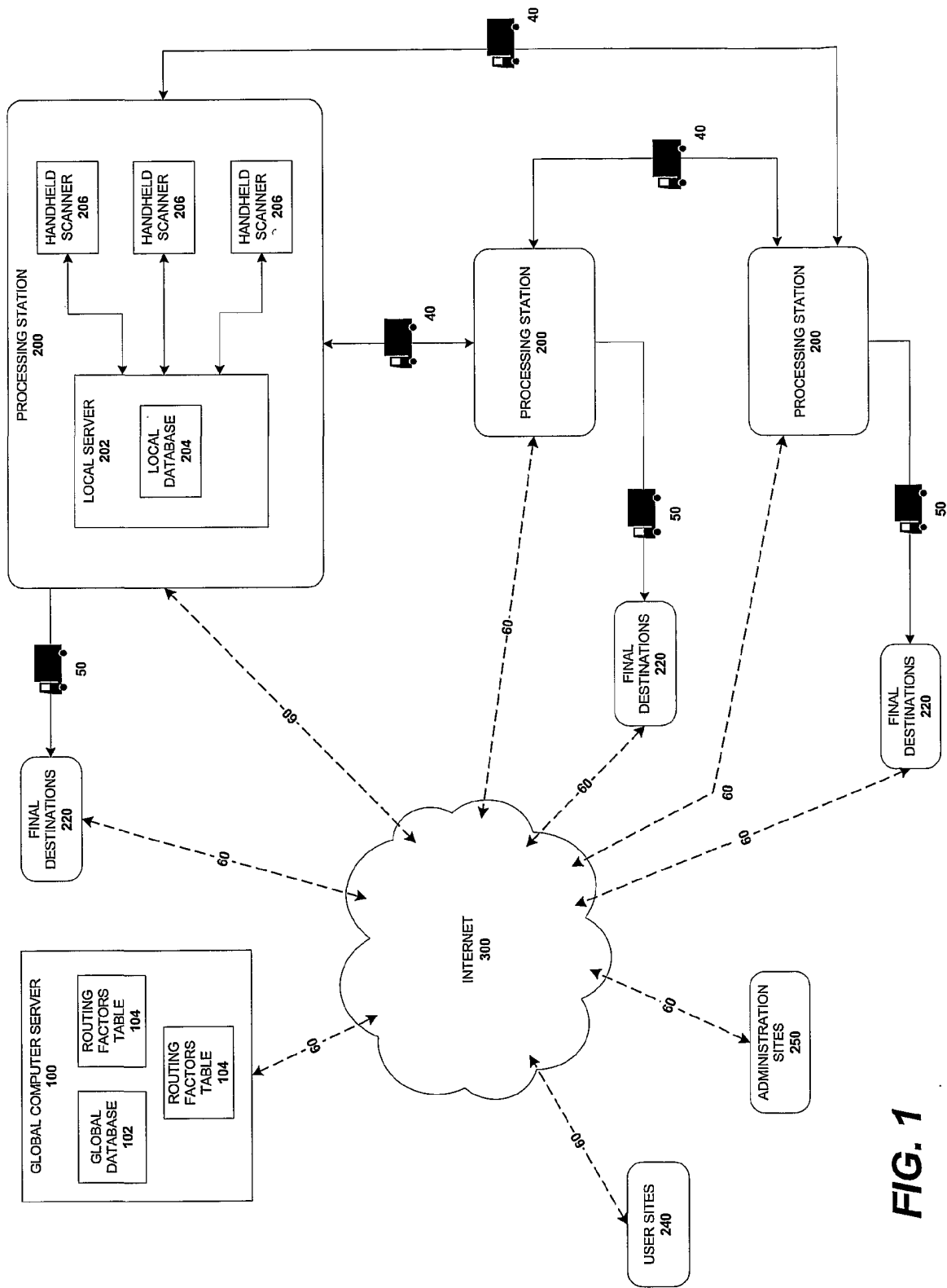
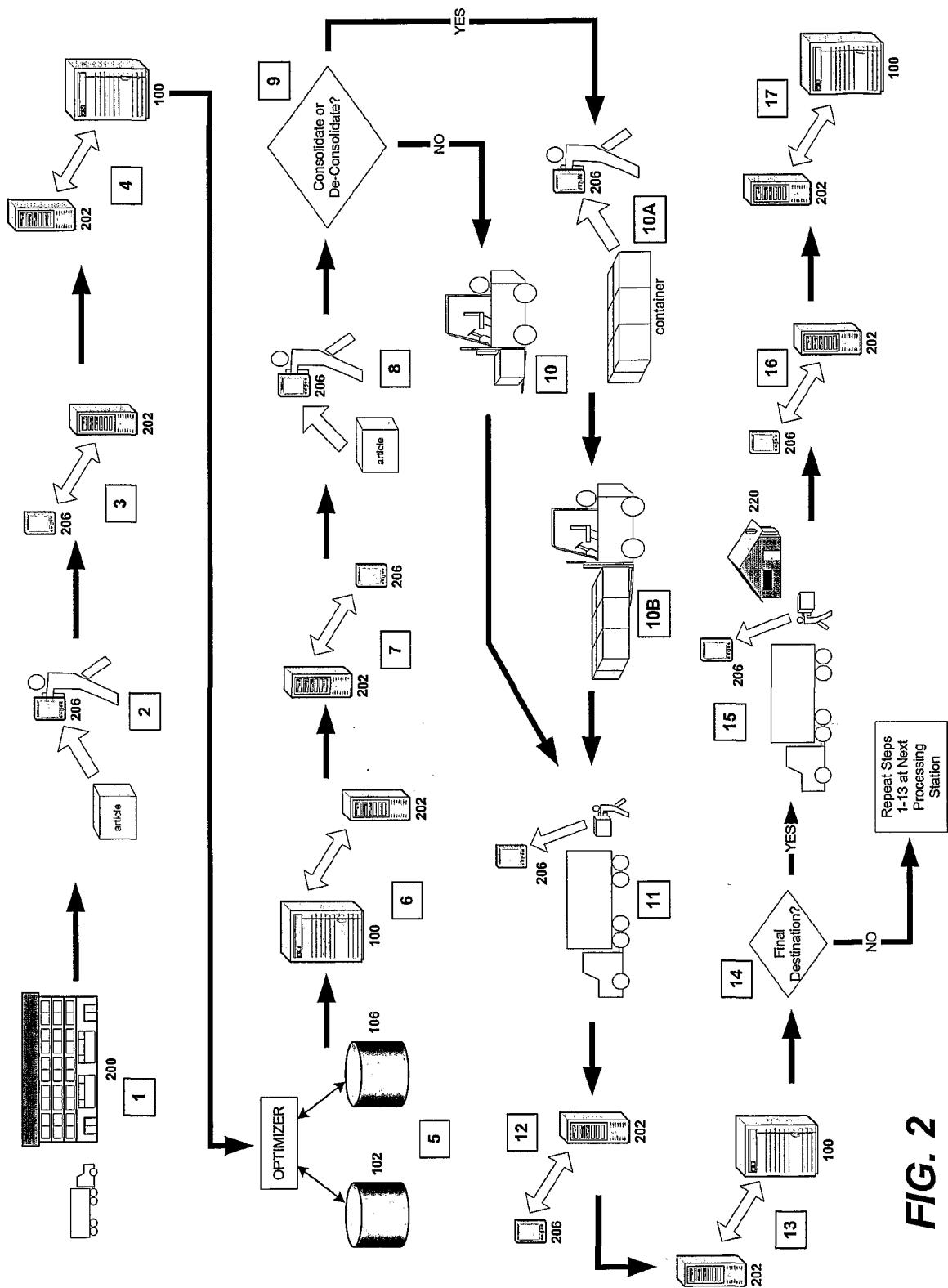


FIG. 1



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/24225

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G05B19/05 G06F17/60

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G05B G06F

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | WO 00 46728 A (UNITED PARCEL SERVICE INC) 10 August 2000 (2000-08-10) page 77 -page 87; figures 10,15,22,23,26,27 --- | 1,2 |
| X | GB 2 332 540 A (IBM) 23 June 1999 (1999-06-23) column 3 -column 6; figures 1,2 --- | 1,2 |
| A | WO 99 33040 A (FJELLBERG ESPEN ;TORP STEIN (NO); TRANSPORTONLINE AS (NO)) 1 July 1999 (1999-07-01) page 1 -page 3; figure 1 --- | 1,2 |
| A | US 5 869 819 A (WILZ DAVID ET AL) 9 February 1999 (1999-02-09) abstract --- | 1,2 |
| -/-- | | |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- * & * document member of the same patent family

Date of the actual completion of the international search

27 June 2001

Date of mailing of the international search report

05/07/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5816 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Tran-Tien, T

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/24225

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| A | US 6 047 264 A (KAPLAN SAMUEL JERROLD ET AL) 4 April 2000 (2000-04-04) abstract | 1,2 |
| A | US 6 094 642 A (BAILEY TRACY ET AL) 25 July 2000 (2000-07-25) cited in the application abstract | 1,2 |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 00/24225

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|--|--|
| WO 0046728 A | 10-08-2000 | NONE | |
| GB 2332540 A | 23-06-1999 | US 6220509 B | 24-04-2001 |
| WO 9933040 A | 01-07-1999 | NO 975999 A AU 1892599 A | 21-06-1999 12-07-1999 |
| US 5869819 A | 09-02-1999 | US 6068188 A US 5844227 A US 5793798 A US 5808285 A US 5557093 A US 5525789 A US 5661292 A US 5591953 A US 5616908 A US 6045048 A US 6076733 A US 5992752 A US 6152369 A US 5905248 A US 6227450 B AU 5367998 A AU 5513498 A AU 7411698 A BR 9713416 A BR 9713425 A BR 9713426 A CN 1256772 A CN 1246939 A EP 0950226 A EP 0958546 A EP 1019844 A WO 9824049 A WO 9824036 A WO 9824050 A US 6027024 A US 5905251 A US 6182898 B US 5767501 A US 5942743 A US 5796091 A US 6073846 A US 6085978 A US 5984185 A US 6112990 A US 6003772 A US 6199759 B US 6085980 A US 5975419 A US 6024282 A US 6062479 A US 5955721 A US 6158659 A US 6006993 A US 6076736 A US 6163564 A | 30-05-2000 01-12-1998 11-08-1998 15-09-1998 17-09-1996 11-06-1996 26-08-1997 07-01-1997 01-04-1997 04-04-2000 20-06-2000 30-11-1999 28-11-2000 18-05-1999 08-05-2001 22-06-1998 22-06-1998 22-06-1998 18-04-2000 25-01-2000 25-01-2000 14-06-2000 08-03-2000 20-10-1999 24-11-1999 19-07-2000 04-06-1998 04-06-1998 04-06-1998 22-02-2000 18-05-1999 06-02-2001 16-06-1998 24-08-1999 18-08-1998 13-06-2000 11-07-2000 16-11-1999 05-09-2000 21-12-1999 13-03-2001 11-07-2000 02-11-1999 15-02-2000 16-05-2000 21-09-1999 12-12-2000 28-12-1999 20-06-2000 19-12-2000 |

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 00/24225

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|---|--|
| US 6047264 A | 04-04-2000 | AU 3904597 A EP 0978075 A JP 2000503790 T WO 9806049 A | 25-02-1998 09-02-2000 28-03-2000 12-02-1998 |
| US 6094642 A | 25-07-2000 | AU 1361799 A EP 1023690 A TW 392126 B WO 9922339 A | 17-05-1999 02-08-2000 01-06-2000 06-05-1999 |